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The Engineer

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PUBLIC NOTICES

The Government of India invite APPLICATIONS for an APPOINTMENT of CHIEF ENGINEER of the Indian State Air Service. Candidates should possess experience of Aircraft Operation and Maintenance of Aero-engines for an Air Line.

Agreement up to the 31st December, 1933, in the first instance. Pay in India Rs. 900 a calendar month. Pay in this country while acting as Liaison Officer before proceeding to India at equivalent of Rs. 675 a month (approximate sterling equivalents £810 and £607 per annum). Free first-class passage to India. Free medical attention. Strict medical examination.

Further particulars and forms of application may be obtained upon request by postcard from the HIGH COMMISSIONER FOR INDIA, General Department, India House, Aldwych, London, W.C. 2. Last date for the receipt of applications 3rd June, 1931. 6990

Armourers' and Brasiers' Company,
IN THE CITY OF LONDON.

LECTURES IN METALLURGY.

The Company have arranged for COURSES of THREE LECTURES to be delivered as follows :—

At the Royal School of Mines, Prince Consort-road, South Kensington, at 8 p.m. on Thursdays, 21st and 28th May, and 4th June, 1931, by
ULICK R. EVANS, Esq., M.A., on
"THIN FILMS ON METALS."

At King's College, Strand, W.C. 2, at 5.30 p.m. on Wednesdays, 27th May, and 3rd and 10th June, 1931, by
Dr. WALTER ROSENHAIN, F. Inst. Met., F. Inst. P., F.R.S., on
"SOME IMPURITIES IN METALS AND THE PRODUCTION OF METALS OF HIGH PURITY."

Admission free, without ticket. 6960

University of Bristol.

FACULTY OF ENGINEERING.

The UNIVERSITY invites APPLICATIONS for the following POSTS :—

A LECTURESHIP in METALLURGY (Grade II.). Salary £400 to £500, according to qualifications.
An ASSISTANT LECTURESHIP in CIVIL ENGINEERING (Grade III.). Salary £300.
An ASSISTANT LECTURESHIP in ELECTRICAL ENGINEERING (Grade III.). Salary £300.
An ASSISTANT LECTURESHIP in MATHEMATICS (Grade III.). Salary £300.

Applications should reach the undersigned, from whom further particulars may be obtained, on or before Tuesday, June 9th, 1931.
WINIFRED SHAPLAND,
6940 Secretary and Acting Registrar.

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that HOOD RUBBER COMPANY, INC., of 7, West 10th-street, Wilmington, Delaware, United States of America, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 314,249, granted to ALFRED ADELBERT GLIDDEN, THOMAS MILLBURY KNOWLAND and LAURENCE HASKELL BURNHAM, for an invention entitled "Method of Manufacturing Footwear and Apparatus therefor."

Particulars of the proposed Amendment were set forth in No. 2208 of "The Illustrated Official Journal (Patents)," published on the 13th May, 1931.

Any person or persons may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.
W. S. JARRATT,
6987 Comptroller-General.

Administrative County of LONDON.

The London County Council invites TENDERS for the EXECUTION of the undermentioned WORKS, viz.:—

(1) Installation of Steam Plant, Laundry Machinery, Steam and Condense, Gas, Water and Fire Hydrant Mains, Heating and Hot Water Supply Apparatus and Mains and Miscellaneous Works at St. James' Hospital, Balham, S.W. 12 ; and
(2) Installation of Four Lancashire Steam Boilers, Economiser, Fittings and Brickwork Settings, &c., at St. James' Hospital, Balham, S.W. 12.

The specification, form of Tender, &c., in respect of each of the above works may be obtained on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, on and after Wednesday, 20th May, 1931, upon payment in each case of £1 by cheque, draft or money order to the order of the London County Council.

This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at The County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Tuesday, 9th June, 1931, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
6988 Clerk of the London County Council.

County Council of the West RIDING OF YORKSHIRE.

SUPPLY OF ENGINEERING EQUIPMENT.

TENDERS are INVITED for the SUPPLY of MACHINERY, LATHE, MILLING MACHINE, GUARDS, SHAFTING, PULLEYS, BEARINGS, GIRDERS, BRACKETS and BELTS, &c., at the Engineering Laboratory at the Shipley Technical School.

Specifications may be obtained on application to the Manager, County Council Stores, Cliff-lane, Wakefield.

Tenders, in sealed envelope, endorsed "Confidential—Machinery, Shipley Technical School," should be sent to the undersigned and must be received not later than 9 a.m. on Monday, the 8th June, 1931.
J. CHARLES McGRATH,
Clerk of the County Council.
County Hall, Wakefield. 6997

PUBLIC NOTICES

Administrative County of LONDON.

The London County Council invites TENDERS for the SUPPLY and ERECTION at Deptford Pumping Station, Norman-road, Greenwich, S.E. 10, of FIVE STORM WATER PUMPING SETS and AUXILIARY MACHINERY. The pumping sets are to be driven by oil engines varying in power from not less than 325 B.H.P. to not less than 1000 B.H.P.; the pumps are to be of centrifugal or mixed flow type and have vertical spindles driven through bevel gearing.

The specification, form of Tender, drawings, &c., may be obtained on and after Friday, 22nd May, 1931, on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, upon payment of £5 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at The County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 29th June, 1931, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
6985 Clerk of the London County Council.

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Wednesday, 3rd June, TENDERS for the SUPPLY of :—

WROUGHT IRON or MILD STEEL PIPING, &c.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.
Offices : The White Mansion,
91 Petty France, Westminster, S.W. 1,
18th May, 1931. 6996

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :
(A) WROUGHT IRON, STEEL and other FITTINGS for CARRIAGES.
(B) GUN-METAL, BRASS, DOOR LOCKS, INDIA RUBBER and other FITTINGS for CARRIAGES.
(C) LAVATORY FITTINGS for CARRIAGES.
(D) CHARCOAL FINISH PANEL PLATES.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Thursday, 21st May, 1931.

A fee of 10s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Friday, 12th June, 1931.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. GRANT,
7003 Secretary.

RAILWAYS.
WAGONS, METRE GAUGE.

The Consulting Engineers to the Mysore Railways (Messrs. RENDEL, PALMER and TRITTON, 55, Broadway, Westminster, S.W. 1), invite TENDERS for TWENTY 4-WHEELED COVERED and TWO 4-WHEELED OIL TANK WAGONS.

Specifications and Tender forms may be obtained from their office on payment of 15s. (which will not be returned).

Tenders must be submitted not later than Friday, 26th June, 1931. 7002

The Bengal and North-Western RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

5 LOCOMOTIVE BOILERS, &c.,

as per specification to be seen at the Company's offices.

Tenders, addressed to the undersigned and envelope marked "Tender for Locomotive Boilers," with name of firm tendering, to be lodged not later than Noon on the 9th day of June, 1931.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
W. R. IZAT,
Managing Director.
237, Gresham House,
Old Broad-street, London, E.C. 2,
18/5/1931. 6994

PUBLIC NOTICES

City and County of Kingston-UPON-HULL.

APPOINTMENT OF 4 ENGINEERING ASSISTANTS.

APPLICATIONS are INVITED for the POSITIONS of ENGINEERING ASSISTANTS in the City Engineer's Department.

(1) Two Senior General Engineering Assistants in Grade "D," at a commencing salary of £365 per annum, increasing by three annual increments of £15 and two of £20 to £450.
(2) One Senior Engineering Assistant with special Town Planning experience, in Grade "D," at a commencing salary of £365 per annum, increasing by three annual increments of £15 and two of £20 to £450.
(3) One Senior Civil Engineering Assistant with special Mechanical knowledge, in Grade "D," at a commencing salary of £365 per annum, increasing by three annual increments of £15 and two of £20 to £450.

Applicants must have had a good technical training and a good experience on engineering works.

The applicants for the positions as General Engineering Assistants must have had experience on important municipal engineering and public works of a general character.

Preference will be given to applicants who are Associate Members of the Institution of Civil Engineers or the Institution of Municipal and County Engineers.

The applicants for the position as Town Planning Assistant must have had experience in the preparation of a town planning scheme and the general administration relative thereto.

Preference will be given to applicants holding the Town Planning Diploma of the Surveyors' Institution, the Institution of Municipal and County Engineers or the Town Planning Institute.

The applicants for the position as Mechanical Engineering Assistant must have had good workshop experience and also experience in a mechanical engineering drawing-office on design, detailing, estimating, &c., and must hold the Associate Membership of the Institution of Civil Engineers or the Institution of Mechanical Engineers.

The persons appointed will come under the direction of the City Engineer and be required to devote the whole of their time to the duties of the office. They will be required to contribute to the Corporation's Superannuation Fund and to pass a medical examination.

Applications, on forms which can be obtained from my office, and accompanied by copies of three recent testimonials, to be addressed to me and delivered at the City Engineer's Office before Noon on Wednesday, 10th June, 1931.

H. HAMER,
City Engineer.
City Engineer's Office,
Guildhall, Hull.
19th May, 1931. 7007

County Council of Middlesex.

WANTED, an ASSISTANT RESIDENT ENGINEER, with special experience in Supervising and Measuring Up of Reinforced Concrete and Stonework. Salary £400 per annum. Length of engagement approximately 2 years. Applications, stating age, experience, and other details, to be sent to the undersigned not later than first post on Monday, 1st June.
A. DRYLAND, M. Inst. C.E.,
County Engineer and Surveyor.
Middlesex Guildhall,
Westminster, S.W. 1. 6961

The Cleansing Committee of the Manchester Corporation REQUIRE the SERVICES of a thoroughly qualified MECHANICAL ENGINEER. The applicant must have a good general knowledge of Refuse Disposal and Waste Elimination Plants, and would be required to take charge under the Director of Public Cleansing of all such machinery and appliances, and would also be required to pass satisfactorily a medical examination and to contribute to the Manchester Corporation Superannuation Fund.

Canvassing in any form, oral or written, direct or indirect, will be regarded as a disqualification.

Further particulars in regard to the duties required may be obtained direct from the Director of Public Cleansing, Town Hall, Manchester.

The commencing salary for the position is £360 per annum.

Applications, stating age and experience, with copies of three recent testimonials, to be addressed to the Chairman of the Cleansing Committee and endorsed "Engineer," and to be received at the Town Hall not later than Ten o'clock a.m. on Saturday, the 30th day of May, 1931.

F. E. WARBRECK HOWELL,
6992 Town Clerk.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ASSISTANT MANAGER. Must be Thoroughly experienced Designer of Conveying and Elevating Plants and Structural Work. State age, full details of experience and salary expected.—Address, P1111, The Engineer Office. P1111 A

ENGINEER (Mechanical) SALESMAN REQUIRED for work in China. Attached British agents Single, age 25.—Reply, Box 1078, c/o Brown's, 29, Tothill-street, S.W. 1. 6986 A

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SITUATIONS OPEN (continued)

ASSISTANT CIVIL ENGINEER REQUIRED for about Six Months on Resident Engineer's Staff on contract in Essex. Must be experienced in Setting Out. Knowledge of Tunnelling and Work under Compressed Air an advantage. State age, experience, salary required and when disengaged.—Address, P1104, The Engineer Office. P1104 A

CONSTRUCTIONAL ASSISTANT WANTED by Electric Power Supply Company. Knowledge of Design, Drawing and Construction of General Building Work, including Reinforced Concrete. Age about 25. Commencing salary £200 to £250, according to qualifications.—Address, 7009, The Engineer Office. 7009 A

REQUIRED for Large Structural Works Abroad, ASSISTANT STRUCTURAL MANAGER, experienced in Heavy Bridge Work, spans 300ft. and over; must have held similar position and also hold a B.Sc. or equivalent degree. Age between 30 and 35. Agreement 5 years. Applicants must give fullest details education, training, work done, present position and salary. State age and whether married or single.—Write, Z.K. 452, c/o Deacon's Advertising Offices, Fenchurch-avenue, London. 6991 A

PUBLICITY.—Well-known MAKERS of AIR COMPRESSORS and PNEUMATIC TOOLS REQUIRE MAN, preferably experienced this branch engineering, Prepare Catalogues, Lists, Advertisements, &c. State experience, age, salary required.—Address, 6999, The Engineer Office. 6999 A

WORKS MANAGER REQUIRED, Boilermakers' Work. Must be good organiser and controller of men. Used to the latest equipment and methods of production. Age 35-45.—Address, giving full experience, salary required, 7016, The Engineer Office. 7016 A

£1000 — MANUFACTURER'S SON REQUIRED as REPRESENTATIVE for London in specialised line. Highest references required and given.—Address, P1095, The Engineer Office. P1095 A

WANTED, First-class DRAUGHTSMAN with Up-to-date experience in Design of Centrifugal and Turbine Pumps. Must be capable of initiating and carrying out competitive designs in their entirety.—Apply, stating age, experience and salary required, CHIEF DRAUGHTSMAN, Tangyes Limited, Cornwall Works, Birmingham. 7006 A

DRAUGHTSMAN, Age 22-24, with First-class Experience of Heavy-oil Engines.—Apply, stating age, experience and salary required, CHIEF DRAUGHTSMAN, Tangyes Limited, Cornwall Works, Birmingham. 7005 A

DRAUGHTSMAN REQUIRED TEMPORARILY to Assist in the Preparation of Plans for Power Station Reconstruction Work. Experience with Pipework essential.—State age, training, experience and salary required, to GENERAL MANAGER, L.C.C. Tramways, 23, Belvedere-road, S.E. 1. Canvassing disqualifies. 7004 A

FIRST-CLASS TRACER REQUIRED Immediately; general Engineering. — Apply, HOWDEN-LJUNGSTROM PREHEATERS, Ltd., Caxton House, S.W. 1, by letter, stating experience, salary, age, specimen work. 7011 A

TEMPORARY DRAUGHTSMAN WANTED, Expert in design of Cranes and Derricks. Full particulars and salary required.—Address, 7000, The Engineer Office. 7000 A

SITUATIONS WANTED

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GOVT. ENGINEER (29), Public School, with Colonial Govt. over five years, carrying out variety heavy construction works and maintenance, steam and Diesel stations, &c. &c., as superintendent, well recommended, OPEN to OFFER suitable EMPLOYMENT abroad from established firm. Details on request.
Address, P1049, The Engineer Office. P1049 B

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THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN,
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BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY.
22, Shakespeare House, 29-31, Oxford St., W.1.
P1043 I

PATENTS

KINGS PATENT AGENCY, Ltd. (B. T. KING, Regd. Patent Agent, G.B., U.S., and Can.), "Advice handbook" and consultations on Patents and Trade Marks FREE.—146A, Queen Victoria-street, London, E.C. 4. 45 years' ref. 'Phone: Central 0682. 6755 H

THE PROPRIETOR of BRITISH PATENT No. 282,335, dated December 15th, 1926, relating to "Improved Pump Operating Mechanism," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above PATENT and ensuring its practical working in Great Britain.
All inquiries to be addressed to:
B. SINGER, Steger Building, Chicago, Illinois. 6965 H

THE PROPRIETOR of BRITISH PATENT No. 251,963, dated May 6, 1925, relating to "Improvements in Heating Apparatus," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 6989 H

THE OWNERS of PATENT No. 282,798 DESIRE to ARRANGE by way of LICENCE or otherwise on reasonable terms for the COMMERCIAL DEVELOPMENT of this invention, which concerns "IMPROVEMENTS RELATING TO THE CYLINDERS OF DOUBLE ACTING TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINES." — For particulars address EDWARD EVANS and CO., Lonsdale Chambers, 27, Chancery Lane, London, W.C. 2. P1110 H

AGENCIES

AGENTS REQUIRED in the Chief Counties, with first-class connections amongst Steam Users.—Apply, OWENS BOILER CIRCULATOR (1930), Ltd., 57, Victoria-street, S.W. 1. 7013 D

AN ENGINEERING AGENCY COMPANY, Glasgow, with valuable connection Shipbuilders, Engineers, Factories, and Railways, OPEN CONSIDER ADDITIONAL AGENCIES.—Address, 7012, The Engineer Office. 7012 D

ITALIAN ENGINEER would be Prepared to CONSIDER AGENCY for an English Firm in Italy.
Address, P1099, The Engineer Office. P1099 D

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H. & T. DANKS (Netherton), LTD.
Boilermakers and Engineers, Netherton, DUDLEY. 5840 G

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FOR SALE, TWO 24in. gauge Hudson 0-4-0 STEAM LOCOMOTIVES, in good condition; £190 each or offers.
Address, 6882, The Engineer Office. 6882 G

FOR SALE, SECOND-HAND BOILER, Lancashire type, size about 30ft. by 9ft.—BROOKS' DYE WORKS, Ltd., Bristol. 7008 G

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N. 1559.—250-kW **Steam-driven Belliss-Crompton Alternator Set.** Triple-expansion engine, direct coupled to 3000-volt, 3-phase, 50-cycle Alternator, 375 r.p.m., direct-coupled Exciter.

N. 1044.—200-kW **Steam-driven Browett-Lindley-Siemens Alternator Set.** Vertical Compound Engine, direct coupled to 550-volt, 3-phase, 50-cycle Alternator, 428 r.p.m., direct-coupled Exciter.

The above sets are all in first-class condition, having only recently left off working.

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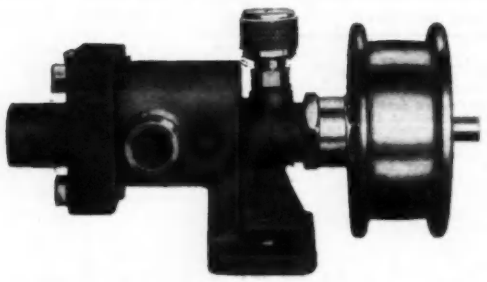

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A Seven-Day Journal

An Argentine Committee of the F.B.I.

THE Executive Committee of the Federation of British Industries, in pursuance of the policy laid down by a resolution of the Grand Council on April 8th, to the effect that the Federation would do everything in its power to follow up the lead which His Royal Highness the Prince of Wales had given to British industry in South America, by his presence at the British Empire Trade Exhibition at Buenos Aires, has decided to create a special Argentine Committee of members interested in trade with that country. The Committee will be composed of the members of the delegation of the F.B.I. to the British Empire Trade Exhibition, together with members of the Overseas Committee more specially interested in Argentine trade. Mr. V. Watlington, who acted as Chairman of the Federation's Delegation to Buenos Aires, has been invited to take the chair at the first meeting of the Committee. In addition to the formation of the Committee, it is proposed to form a group of all members of the Federation interested in trade with the Argentine, with which the Committee can keep in touch with a view to following up the work initiated at the Buenos Aires Exhibition. Plans are already under consideration by the F.B.I., and will be submitted to the Committee for strengthening British industrial representation in Argentina, and for inaugurating a regular and permanent system of publicity for British goods in that market.

The Telephone Service.

ON Friday, May 15th, the Postmaster-General sought and obtained from the House of Commons a grant of £29,200,000 for the development of the telephone service during the next three years. The task of justifying the demand fell upon Mr. Viant, the Assistant Postmaster-General, who indicated that a system of intensified canvassing was to be adopted to increase the use of the telephone. Those who suggested that this country had a relatively low number of telephones appeared to ignore the fact that only two countries, namely, the United States of America and Germany, excelled Great Britain in that respect. The obstacle in the way of development was British conservatism, which was inclined to regard the telephone as a nuisance rather than as an essential equipment. The use of the telephone was, nevertheless, increasing at a remarkable rate, and, coupled with that progress, there had been a marked improvement in the quality of transmission. The Ministerial optimism was not, however, shared by the House as a whole, and Lord Wolmer bluntly described the telephone statistics as deplorable. He saw no hope of the country having a telephone equipment commensurate with its economic needs until there had been thorough reformation of the Post Office. The plant investment cost of the telephone system in Great Britain worked out at £77 per instrument, whereas in America it was only £47 per instrument. His cure for the present evils was that the Post Office should be managed by a public utility corporation, such as was proposed for London traffic, divorced alike from politics and the Civil Service.

The Canadian Destroyer Saguenay.

BY the courtesy of Sir John Thornycroft a party inspected the new Canadian destroyer "Saguenay" last Monday, May 18th. This destroyer is now nearing completion at Southampton, and will sail for Halifax early in June. When asking for tenders for the vessel, the Canadian Government desired a design that would be capable of operating in conjunction with the British vessels of the "Acasta" class, while, at the same time, certain alterations should be made from the British prototype to meet the conditions of Canadian service. In consequence, the "Saguenay" is very similar to the ships of the "Acasta" class. She is 321ft. long, with a breadth of 32ft. 6in. Her displacement is 1320 tons and her designed speed 35 knots. The machinery consists of single-reduction geared turbines, developing about 34,500 horse-power. The armament is the same as that for the British vessels—four 4·7in guns and eight 21in. torpedo tubes. To withstand accumulation of ice on the upper decks, bridges, &c., heavier scantlings have been included, while an elaborate heating system is fitted in order to meet climatic conditions. The accommodation for officers and crew differs somewhat from that of the British vessels, and is on a larger scale to meet Canadian requirements.

Absenteeism in Coal Mines.

ACCORDING to a report which was published last Monday, May 18th, by the Industrial Health Research Board, absenteeism in coal mines is greatly influenced by economic conditions, for when the possible earnings of the coal face workers fell 32 per cent., the time lost by voluntary absenteeism fell to a half, and that lost by sickness fell to three-fourths, but absenteeism from accidents was slightly increased. The other underground men were still more affected, for when their possible earnings fell 24 per cent. their absenteeism from voluntary causes, sickness, and accidents fell 38, 20, and 17 per cent. respectively. Surface men showed intermediate reductions. Data for 1927–28 confirm those obtained in 1924–26 in showing that with rise of underground temperature there was a considerable increase of sickness absenteeism. There was likewise a marked increase of accident frequency. The increase related chiefly to minor accidents, those entailing less than ten days' disablement being three times more numerous at an underground temperature of 81 deg. than at one of 63 deg.; whilst major accidents causing sixty or more days' disability were rather less numerous in coal face workers at high temperatures than at low temperatures. Voluntary absenteeism appeared to be closely associated with the labour turnover at the various collieries, and with the distance the men had to walk underground from pit bottom to working place. It was also related to the distance of the homes of the men from the colliery. An investigation of the same type was made at seven Scots collieries with similar conclusions, but the low absenteeism rates for Scotland could be to some extent accounted for by the partial exclusion from the returns of absences on account of sickness and accident. Attention is drawn to the desirability for a more uniform statistical method.

Obsolete Ships.

THE report of the committee appointed by the Board of Trade to consider the economic factors involved in the disposal of old ships and to advise whether it is desirable in the national interest that steps, not involving a grant from public funds, should be taken to encourage the process, has now been issued as a White Paper. The considered opinion of the committee is that any scheme involving either replacement or restriction upon the shipowners' freedom of sale, even if practicable, would not be in the national interest. The committee evidently found at the outset some difficulty in laying down any hard-and-fast rule as to the age when a ship becomes obsolete. Normally, it states, 25 years may be taken as the average length of life of a cargo steamer, while passenger liners and tankers have probably a little shorter life, and tramp steamers and special vessels a little longer one. Against this, a few vessels built over 40 to 50 years ago are still giving good service, and the obsolescence factor is obviously influenced by developments in shipbuilding and marine engineering and other factors such as trade, maintenance, &c. There appears, it observes, to be no evidence to the effect that the proportion of old vessels on the United Kingdom registers is tending to increase. Shipowners themselves have pointed out that the present surplus capacity is principally caused by trade depression, and the true remedy would seem to lie in an increase of cargo to carry, which can only take place with the revival of the import and export trades. Any scheme of scrapping, or scrapping and replacement, would, the committee feels, be difficult to finance, and impracticable to apply equitably, as between the individual concerns.

The United Kingdom Trade Mission to Egypt.

THE report of the United Kingdom Trade Mission to Egypt has now been published. The Mission was appointed by the Foreign Secretary to inquire into the present position of trade between the United Kingdom and Egypt and to report what action should be taken to develop and increase the trade. The principal reason cited for the reduction of our business with Egypt is that our prices are too high. A complete overhaul of our costs of production is advocated. It is suggested that this overhaul could be effected by the co-operation of the State, financiers, trade unions, and workers. The taste of the Egyptian should be carefully studied, preferably on the spot. British goods in some cases are too substantial and too good for customers who value cheapness above quality and want flashy designs and bright colours. The decline in trade affects principally cotton and coal; if these are excluded the remaining markets are healthy, both absolutely and in relation to other countries. The percentage of the total value of cotton piece goods imported into Egypt obtained from the United Kingdon are given as 81·8 per cent. in 1913 and 42·8 per cent. in 1930. British prices are too high, and room for improvement is found in the style and attractiveness of goods, in methods of packing, and in advertising. Recommendations are included as to the best methods of making arrangements with agents.

Centenary of David Hughes.

AT a meeting of the Institution of Electrical Engineers, held on Thursday, May 14th, Mr. Sydney Evershed gave a short account of the work of David Hughes in commemoration of the centenary of his birth. Born in London on May 16th, 1831, Hughes was taken to Virginia at the age of seven, and twelve years later was appointed Professor of Music at St. Joseph's College at Bardstown, Kentucky. In 1852 he was devoting his spare time to inventing a printing telegraph instrument. In 1854 he resigned his teaching appointments in order that he might devote himself entirely to this work, and a year later he had an instrument in successful operation. When he returned to England in 1875 and settled down in London he was well on the way to making a large fortune out of his invention, and at the age of forty-four, with ample means at his disposal, found leisure for experimental research. Towards the end of 1877 he invented the microphone, which was described in a paper read by Professor Huxley before the Royal Society on May 8th, 1878. Subsequently he invented an induction measuring balance, which was expected to prove useful in various ways, but, unlike his other two inventions, it was found to have a very limited field of application. Some eight years before Hertz made known his experiments with electromagnetic waves, Hughes discovered that signals could be transmitted without wires over distances up to two or three hundred yards, and apparently he contemplated reading a paper on his discovery before the Royal Society. Unfortunately, however, the President of that Institution, Mr. Spottiswood, and two honorary secretaries, Professors Huxley and G. Stokes, opposed the idea, and the paper was never produced. Hughes was elected a Fellow of the Society in 1880 and in 1885 was awarded its gold medal. In 1886 he became President of the Institution of Electrical Engineers. He died on January 22nd, 1900, leaving a large sum of money to hospitals and scientific bodies.

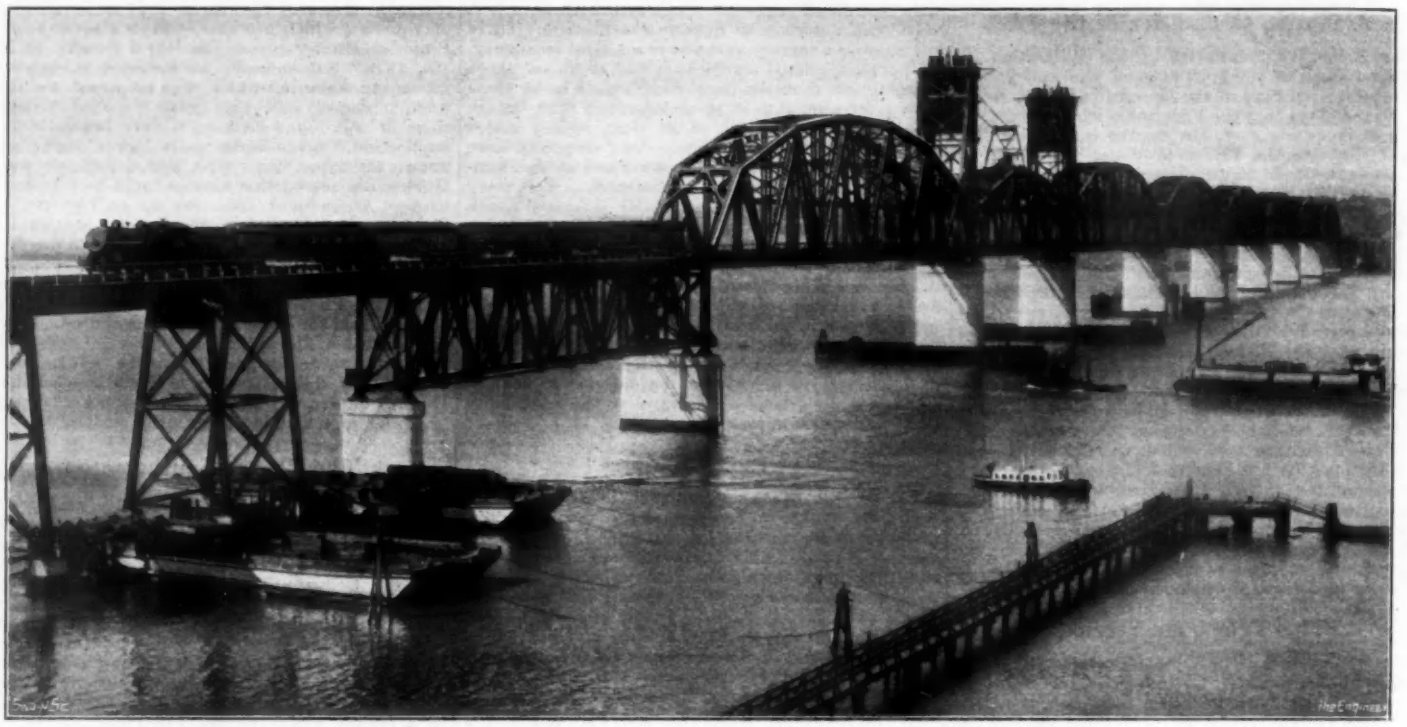
The Port of Southampton.

IN the course of a speech recently made at the third annual dinner of the Southampton Dock extension staff, Lieut.-Colonel G. S. Szlumper, the assistant general manager of the Southern Railway Company, referred to the good progress now being made with the dock work. During the past month, he said, two world's records had been established, one for dredging and the other in the driving of sheet piling around the new graving dock. The James Dredging, Towage and Transport Company, Ltd., had lifted 500,000 cubic yards of material in a month, which represented some 750,000 tons. According to Mr. M. C. J. MacHaffie, the resident engineer, something like 15 million tons of spoil have now been lifted from the bed of the river Test since beginning the work, and some sixty vessels of all descriptions are being employed in the dredging operations. Colonel Szlumper went on to say that although last year was one of depression, no less than 7500 ships were handled at Southampton, representing over 34½ million tons. On several days over a quarter million tons of shipping was dealt with, which showed the need of extensions to the port. On Tuesday last, May 19th, there was an influential gathering of those interested in shipping at Southampton, when, at a conference called by the Southampton Harbour Board, the question of improving the approaches to Southampton was discussed. The speakers included both outward and inward pilots, and representatives of the Cunard, White Star, and North German Lloyd lines. It was urged that improvements were badly needed at the Fawley Beacon and at the Brambles entrance, while a direction-finder and a fog signal were required at the Nab Tower. The problem of navigating ships in the vicinity of the West Brambles Buoy was also discussed. The Harbour Board has been requested by the Board of Trade to furnish at an early date its observations on the matter of improving the approaches to Southampton.

Railway Operating Costs.

ON behalf of the Traders' Co-ordinating Committee, Mr. S. E. Cash recently made a statement before the Railway Rates Tribunal in which he said that the present position of the railways was a matter for regret in all quarters, and that it was to the national interest that they should enjoy a fair measure of prosperity. That prosperity, however, could not be obtained by a system of high rates and charges, and the railway companies seemed to have adopted that view to some extent. A policy of low rates and charges was desirable, not only in the interests of the railways, but also for the prosperity of the industry of the country. Traders trusted that the companies would explore every avenue in order to find some method by which they could bring forward proposals for a very substantial decrease of the standard charges and also of exceptional rates. The time must come soon when, unless the railway companies did take the initiative, some steps would have to be taken on behalf of the traders to try and bring about that result. As some indication of the lines upon which the traders suggested that the railway companies might proceed, he mentioned the question of operating costs. Considering the much reduced volumes of traffic those costs were quite out of proportion with what they ought to be if the railways were efficiently and economically worked. No doubt it would be said that many of the commodities used by the railway companies were being obtained by them at far less cost than formerly, but that was all the more reason why the other items should be carefully scrutinised. In support of his contention, Mr. Cash put forward the following figures:—Railway expenditure in two years had fallen 3·94 per cent.; the percentage of railway working expenditure to gross receipts in two years had risen 0·95 per cent.; in the same period tonnage had fallen 0·45 per cent.; and gross receipts, 5·04 per cent.

MARTINEZ-BENICIA BRIDGE, SUISUN BAY, CALIFORNIA



The Martinez-Benicia Bridge, Suisun Bay.

(By a Correspondent.)

THE official dedication to public service on November 1st, 1930, of the recently completed Martinez-Benicia Bridge, erected by the engineers of the Southern Pacific Railroad in the record time of eighteen months at a cost of £2,400,000, concluded a piece of engineering work deserving of more than ordinary notice. This 5603ft. bridge is the longest and heaviest two-track structure west of the Mississippi River, and is not exceeded in its load-carrying capacity by any bridge in America. It spans Suisun Bay, in the upper reaches of San Francisco Bay, near the confluence of the Sacramento and San Joaquin rivers, and is situated about a mile and a-half east of the present train ferrying point between Benicia and Port Costa.

Its opening for train service marked the finish of the West's greatest construction project for 1929–30, and its completion has caused the retirement of the "Solano" and "Contra Costa," the largest ferry boats in the world, which have for so many years been a fascinating part of transcontinental rail service, and will make possible the faster and more convenient handling of passenger and goods trains over the Overland and Shasta routes.

Unusual features in the construction of the bridge were:—First, the creation of artificial islands of sand, by means of which concrete piers were built above water and sunk to bed rock; second, use of a deep-sea diver to examine all pier foundations; third, construction of piers resistant to earthquake shock; and fourth, temporary use of one of the steel deck spans as falsework during construction of the permanent spans across deep water.

The deep-water piers presented a difficult construction problem. The depth of the water prevented open cofferdam work or the use of the pneumatic process. It was proposed to sink caissons by the open well dredging method, but the depth of the water, a maximum tidal fluctuation of about 10ft., the swiftness of the current during winter floods and at rip tide, and the softness of the underlying bay deposits, made the launching and sinking of a timber crib most difficult.

Finally the following method of constructing the piers was determined upon. Piles were driven around the pier site and an octagonal-shaped platform was erected on top of them. On this platform eight steel towers containing winches with cables passing over sheaves at the top of the frames were erected. By means of this apparatus a steel shell—see Fig. 1, page 574—81ft. in diameter was erected and lowered through the water into the mud, which it penetrated to a depth of 15ft. to 50ft., depending on the compactness of the material. The shell was built up of circular sections 10ft. in height, each of which was bolted to the top of the shell as it was gradually sunk into the water. When the shell had touched bottom it was filled with sand dredged from the surrounding waters. The island area of sand thus created within the shell permitted the exact staking out and fabrication of the steel cutting edge of the caisson that was to be sunk to rock.

Portable steel forms were erected above the caisson cutting edge and reinforcing steel placed in them—see Fig. 2. Concrete was then poured in successive lifts of 10ft. in height, all this work being done above water. The caisson was so designed that it contained six wells, by means of which sand could be removed from the interior with the aid of clamshell excavators. As the sand was withdrawn the caisson gradually settled to the underlying strata.

Upon landing the caisson at or near bed rock, and after the greater part of the material immediately above bed rock had been removed by hydraulic jetting and clamming, a deep-water diver was sent down to explore the bottom. He telephoned from deep water the conditions existing within and under the caisson, and gave accurate information as to the penetration of the cutting edge of the caisson into the foundation rock. In each inspection he brought to the surface samples of the rock encountered, which furnished helpful information. It is believed that this is the first time that a deep-sea diver has been used in the construction of bridge piers sunk to such great depth of water. His inspections permitted the engineers to verify the diamond drill borings and informed them definitely as to the nature of the bed rock formations. The inspections also assured that the bridge piers were actually resting on bed rock, that the full bearing had been secured and that an interlocked connection had been established between the concrete and the cutting edge and the bed rock.

The deepest pier is at the north end of the lift span. It is 207ft. from bed rock to bridge seat, has a base area of 40ft. by 60ft., and weighs some 19,000 tons. There are ten main bridge piers and twenty-two pedestal piers on viaduct approaches. More concrete went into the construction of any one of the ten main piers than was used in San Francisco's loftiest skyscraper. One of these piers is seen in Fig. 3.

Another notable feature of construction was involved in erecting the steel spans in the superstructure. Various methods were considered, but it was deemed not possible to use timber piling successfully and economically owing to the depth of water, softness of underlying mud, water current, and height of piers above water. It was finally decided to use one of the steel spans as falsework for the erection of all the other spans. This span finally took its place as the most northerly span in the bridge. It was erected on piling sunk in the shallow waters at the south end of the bridge. On its completion it was floated by means of two steel barges from its original position to a position between the first two deep-water piers at the south end of the bridge—see Fig. 4. The span was rested on shoulders provided in the construction of the concrete piers. When in position the top of the falsework span was below the level of the permanent span to be constructed over it and gave a temporary foundation on which to erect the permanent span. After the permanent span was completed the falsework span was again floated on steel barges and moved into a new position between the succeeding piers.

The steel superstructure—see above—consists of seven 526ft. through Warren truss spans; two deck spans of 264ft. and 504ft. length; one 328ft. vertical lift span; a 560ft. viaduct at the south end and a 220ft. viaduct at the north end. The south approach involved the construction of 1·35 miles of track, branching from the main San Joaquin Valley line near Martinez. The north approach required the construction of 4·57 miles of new track, including a 1860ft. viaduct. A new station was built at Benicia Junction.

Ninety-five per cent. of the ships now using Suisun Bay can pass under the bridge, which has a clearance of 70ft. above mean higher high water, but the vertical lift span erected over the deep-water channel can be opened to a clearance of 135ft. in ninety seconds. It is normally operated by electricity, but an oil engine is provided for auxiliary or emergency use.

The bridge is designed to carry a load its full length 50 per cent. heavier than that imposed by the trains now being operated. It could bear double-headed consolidation locomotives with 90,000 lb. per axle on each track, followed or preceded by a uniform load of 7500 lb. per foot. As a 50-ton box car fully loaded weighs 169,000 lb., or only 4200 lb. per foot, the great margin of strength will be appreciated.

Besides the usual maritime lighting system and the railroad signals, the bridge is topped by a series of red lights and a giant 24in. signal beacon of 2,000,000 candle-power, which every 30 seconds flashes its signal light to aviators.

Surveys were begun in June, 1927, but that was not the first time consideration had been given to the construction of a bridge across this arm of San Francisco Bay. The first rail line to the Bay was built from Sacramento, by way of Stockton and Niles Canyon, in 1869. The heavy gradients of Altamont Pass made this roundabout route unsatisfactory, and in December, 1879, there was completed the more direct low-level route through Port Costa, and across Carquinez Straits to Benicia and Suisun, where connection was made with the line into Sacramento, originally built by the old California Pacific Company.

Late in the 'eighties and again in 1904, various sites for a bridge were considered. Test piles were driven, but the surveys did not reveal the exact character of the bedrock. It was once proposed to build a low-level bridge consisting of swing draw span and ballast deck trestle approaches, but the War Department refused permission. A crossing near Antioch was also disapproved. The existence of well-established earthquake faults, together with other unfavourable conditions, caused the rejection of all routes proposed over Carquinez Straits.

Complete surveys, designs and estimates were made in 1927. Diamond drill tests over the present site from Army Point to Suisun Point revealed that rock extended across the channel at varying depths. Geologists and paleontologists, making microscopic studies of the fossils obtained in these borings, concluded that no earthquake faults crossed the bridge location. However, all the piers are designed to resist earthquake vibrations twice the intensity of that which accompanied the San Francisco disaster in 1906. The concrete used in the piers has a compressive strength of 2500 lb. per square inch at the end of

28 days. The piers have 30 lb. of steel reinforcement per cubic foot.

The first shovel of dirt was moved at Suisun Point on May 3rd, 1929, but actual construction on the bridge site was not begun until the month following. Its completion ahead of schedule sets a record for engineering projects of the kind. The placing of 21,000 tons of steel in nine truss spans, the lift span and towers and in the viaduct approaches, was completed in eleven months.

Surveys, estimates and all preliminary negotiations were carried out by C. R. Harding, then engineer of standards under former President William Sproule. Construction work was carried on under the direction of Mr. Harding, now assistant to President Shoup, and W. H. Kirkbride, engineer of maintenance of way and structures. They were assisted by G. W. Rear, engineer of bridges, and H. I. Benjamin, assistant engineer of bridges, who were in charge of the field work. S. A. Roake, chief designer, designed the foundation and superstructure.

The Ferry Boats.

A bridge across Carquinez Straits was not considered economically feasible in 1879. The "Big Four" railroad builders may have envisaged the development that was to take place in the next fifty years, but there was not then the traffic to justify investment in a bridge. The ferry steamer "Solano" was, therefore, built to carry passenger and freight trains across the straits.

Constructed at the old Central Pacific shipyards in West Oakland, this huge ferry boat attracted international attention. It was the first time that the principle of a truss bridge was used in constructing a hull. Being 420ft. long, 116ft. wide and 17ft. high, it was the largest ferry boat in the world. It had a displacement of 5450 tons, and was capable of carrying on its four tracks, two locomotives and 24 passenger cars, or two locomotives and 36 freight cars. Its trial trip on November 24th, 1879, was the occasion for a big celebration. Charles Crocker, then president of the Southern Pacific, headed a delegation of railroad and public officials aboard the boat, and when it arrived at Benicia, a salute of twenty-six guns was fired from the Government arsenal.

The "Contra Costa," also built at the West Oakland yards, was added to the service in 1914. It is 13ft. longer than the "Solano," 2ft. higher, and has a displacement of 7198 tons. Its carrying capacity is the same. With the completion of the bridge, both of the boats will return to the shipyards, where they will be dismantled.

Electrification of the Manchester-Altrincham Railway.

No. II.*

In our preceding article we described the general scheme of the newly electrified railway line between Manchester and Altrincham and the machinery which has been installed for providing it with a supply of electric power at 1,500 volts D.C. In the following notes we give some account of the equipment, which has been manufactured by the General Electric Company, of Magnet House, Kingsway, London, for the motor coaches that utilise that unusually high voltage, for this country, for D.C. traction.

There are three types of coaches—a motor coach equipped with its driving motors and control gear at one end, a trailer coach having control gear—for an attached motor coach—at one end, and simple trailer coaches. There are in all sixty-eight coaches. It is thus possible to make up trains of from two to nine vehicles. The motor coaches weigh about 57 tons apiece and the trailers 30 tons each.

The power equipment of each motor coach comprises four D.C. series-wound interpole motors, two being mounted on each of the two bogies. Each pair of motors is permanently connected in series to operate from the 1500-volt line, so that while individual motors are wound for 750 volts, all are insulated to withstand 1500 volts to earth. They are rated at 328 H.P., 675 volts, the average line pressure being assumed at 1350 volts, on temperature rise limits in accordance with a British Engineering Standards Specification.

With three-coach train units an acceleration of 1·43 miles per hour per second is called for, the figure being slightly less for larger train units. This acceleration is well within the capacity of the motors.

Each motor coach develops a tractive effort during acceleration of approximately 23,000 lb., while the approximate tractive effort per coach corresponding to the hourly and continuous ratings of the motor are as follows :—

	lb.
Hourly rate, full field	17,600
Continuous rate, full field	11,000
Hourly rate, weak field	15,000
Continuous rate, weak field	9,000

As the motors are required to run up to very high speeds, corresponding to a specified track speed of 70 miles per hour, their mechanical design has received special consideration and is particularly robust. The armature laminations are mounted on a steel spider and the commutator is carried on an extension of that spider, so that, when the shaft is withdrawn, the commutator, core and winding remain undisturbed in relation to each other. The armature of the motor runs in sleeve bearings lubricated on a patented system in which oil is lifted from the save-oil chamber by means of a pneumatically operated injector connected with the compressed air supply of the train. The process of lifting the oil is effected when the coach is taken out of service at night or before it starts in the morning, the injector system being completely isolated from the compressed air supply during service. Oil which has passed through the bearing into the save-oil chamber is returned to the main reservoir on that side of the bearing where feed oil is contained. The oil from this point is fed to the bearing by the capillary action of a wick, so that any grit or impurities which may have been introduced are prevented from reaching the running parts.

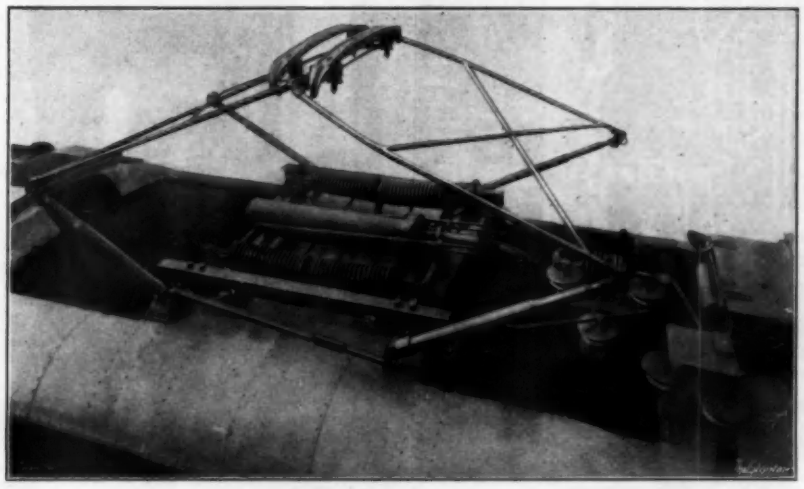


FIG. 10—COLLECTING PANTOGRAPH

The insulation of the motor is mainly of mica, cotton being used only in positions remote from the actual conductors. A double fan ensures a positive stream of cooling air through the core of the armature, over its periphery and between the field coils.

The 1500-volt current supply for the motors is collected from the overhead line by means of pneumatically controlled pantographs—see Fig. 10—which have been designed with the object of maintaining an approximately even pressure under the overhead line at all the varying heights occurring along the track. The inertia of the pantograph has for this reason been reduced to the minimum. This feature is of considerable importance, as there are on the route many low bridges, which necessitate frequent change in the height of the overhead line.

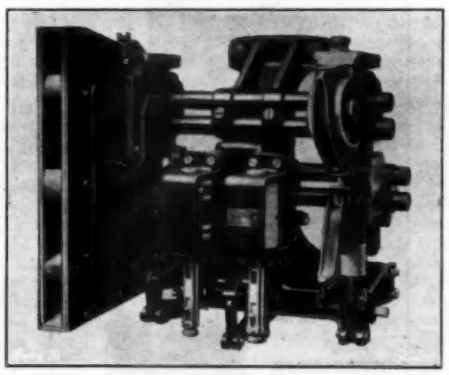


FIG. 11—MAIN CIRCUIT BREAKER

A push button, situated behind the driver in the driving cab of each motor coach, operates the valve of the pneumatic cylinder of the pantograph and a master switch provides remote control of all the pantographs on a train as soon as one pantograph is raised. A hand pump is also fitted for raising the pantograph when the compressed air supply is not available.

Adjacent to the pantograph there are mounted on the roof a main fuse for the protection of the complete equipment, a lightning arrester of the "condenser and gap" type and a choke coil. The current is conducted through a roof insulator and is directly led to the equipment earthing switch, which must automatically be earthed before the equipment can be handled for maintenance or inspection. Directly following this switch is the main circuit breaker—Fig. 11—which controls all the 1500-volt circuits fed from the pantograph. From the earthed side of the circuit breaker the feed is branched for the main motor circuits and for the auxiliary circuits. The main circuit breaker is capable of rupturing any short-circuit current to which it may be subjected, and is designed generally on the lines of a solenoid contactor, with, however, specially large contacts and extended arc chutes. Two breaks in series are provided.

The circuit breakers are not arranged for fully remote control, but are "set" individually by hand on each motor coach. A master switch is provided, however, in each driver's compartment for tripping all circuit breakers on a train in case of emergency. The earthing and isolating switches controlling the motor feed circuit are so interlocked that access to the high-tension apparatus is obtainable only when it is isolated from the 1500-volt supply.

All the high-tension apparatus on the motor coach is arranged in a compartment illustrated in Fig. 12, adjacent to the driver's compartment. This compartment has an inner chamber in which the whole of the auxiliary controls, i.e., the 1500-volt control apparatus for the heater circuits, for the compressors and for the motor generators are accommodated. In this way it is made possible, by the interlocking provided, for an inspector to enter the outer compartment for overhauling the main power equipment, while the auxiliary equipment is kept in operation to provide compressed air and low-tension supply for lighting and testing. This provision is necessary from the fact that it was desired to avoid the use of batteries. The inner high-tension chamber can be entered only when the whole equipment is definitely isolated.

Complete safety interlocking is carried out in the following manner :—The door giving access to the outer chamber can only be unlocked by the "reverse" key taken from the master controller. The unlocking of the door disconnects all motor circuits from the pantograph and earths them through a drum type motor isolating switch. As soon as the door is opened this switch is locked in the isolating position, from which it cannot be moved until the door is again closed. The isolating switch itself is fixed in the inner high-tension chamber, as one of its terminals remains alive so long as the auxiliaries are energised. The protection afforded accordingly is dual, by reason not only of isolation, but also because the equipment affected is earthed.

Access to apparatus in the inner high-tension chamber is possible only by the use of the control switch operating key, the removal of which from the control switch necessarily shuts off the control supply to all auxiliaries. The key is used to open a double lock on the panel at the rear of the driver. By moving the first lock from normal running position to the "dead" position, the pantograph pneumatic cylinder is exhausted, disconnected from the air supply, and consequently falls. The key is then removed and the second lock turned to the "dead" position. This releases the main interlock mechanism and permits a hand wheel on this mechanism to be moved to the "dead" position. The pantograph is then earthed and the covers of the inner high-tension chamber can then be removed. On any one of these covers being taken off, it locks the interlocking mechanism, so that it cannot be returned to the "live" position before the cover is replaced. The main interlocking mechanism further operates through the roof to prevent access to the main fuse unless the pantograph has been lowered. It will be seen, therefore, that the interlocking provided affords a very complete measure of safety.

Returning to the main power circuit, the feed from the isolating switch passes through the overload relays, the line switches, resistances, reversers, motor isolating switches, and field tap switches.

The contactors employed are of the electro-pneumatic type—see Fig. 14—and are operated by compressed air cylinders, the admission and release of air to which are controlled by small solenoid-operated valves. The valve-operating coils being of relatively small capacity, the control currents are in consequence

* No. I. appeared May 15th.

more easily dealt with than on "all-electric" equipment. The energisation of a valve solenoid admits air below a piston, which is forced upward against a strong return spring and closes the contact jaws. The jaws are provided with the usual "knuckling" feature, furnishing a wiping action and ensuring clean contactor tips. The powerful closing pressure provided by the compressed air allows the use of a heavy return spring for opening the contactor, thus avoiding the risk of "welding in." The continuous loss of air past the piston is obviated by making the piston, at the end of its stroke, butt against a leather washer, and so definitely seal the whole chamber.

The reversers are of the electro-pneumatic type—see Fig. 15—operated by an air engine controlled by pneumatic valves. Interlocking mechanism prevents their movement while the motor circuits are carrying current.

Shunt transition is employed, and the motors are arranged for one step of field tapping. The contactors, together with reversers, overload relays, accelerating relays, and all main apparatus, are mounted on a frame in the H.T. chamber. The main resistances are mounted above the apparatus at the top of the frame, and are provided with double insulation. Careful consideration has been given to the ventilation of the chamber in order to ensure proper dissipation of the heat generated.

The driving cab equipment comprises a master controller and an "overload-reset" push button for resetting the overload relays, a trip cock isolating switch for use in the event of automatic signalling being adopted at a later date, the pantograph master switch, the circuit breaker master trip switch and the compressor main switch, together with the main control switch. Two ammeters are provided for indicating the current taken by each pair of motors, and the usual driver's brake valve and duplex air gauge for the Westinghouse compressed air brakes. A second air gauge is installed to indicate the pressure in the control air reservoir, which is fed through a reducing valve from the main air supply. A view of the driving cab is given in Fig. 13.

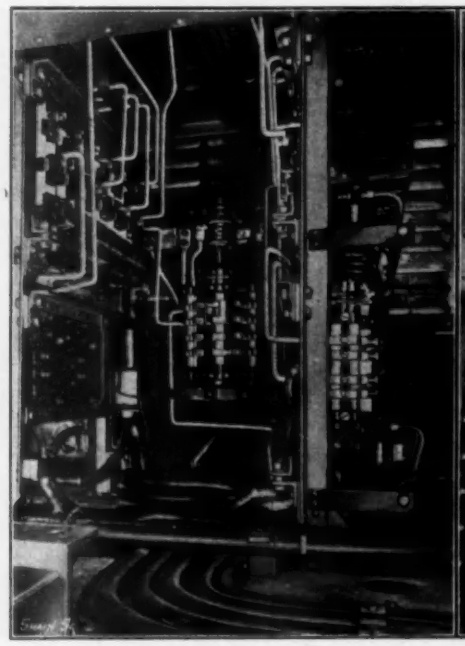


FIG. 12—HIGH-TENSION COMPARTMENT

FIG. 13—DRIVING CAB

AUXILIARY CIRCUITS.

The auxiliary circuits are particularly interesting. As has already been indicated, the feed for these circuits is taken from the negative side of the main circuit breaker. From there it is led through a special 1500-volt cartridge fuse and, before branching to the compressor and motor generator set, passes through a small protective resistance which functions as a limit resistance in case of short circuit. The ohmic value of this resistance is too low to have appreciable effect under ordinary working conditions.

The compressor is of the reciprocating type and is mounted beneath the car frame. Its 1500-volt driving motor is controlled directly by means of a single contactor operated from the master governor, the circuit being protected by a separate 1500-volt fuse. The master circuits are so arranged that normally all compressors of a train are synchronised when operating. Actually one compressor is sufficient for the requirements of a normal train. Any compressor can be separately isolated so that it is virtually impossible for a fault to occur which would occasion failure of the compressed air supply.

The second branch of the auxiliary high-tension circuit passes through a high-tension fuse to the motor generator contactor. The motor generator has a capacity of 12 kW and supplies low-tension current for control and lighting at approximately 110 volts. By a special arrangement of compounded field the voltage variation on the low-tension side is maintained within very close limits. On account of the size of the machine a starting step is provided by means of a second contactor automatically closed shortly after the first. The machine is provided with both series and shunt fields, shunt excitation being supplied at 1500 volts through a series resistance.

The machines are started and stopped by push-button control, one motor generator set being sufficient to supply the low-tension current requirements of a train unit up to six coaches. A low-tension jumper system is provided which prevents the "bussing" of any two motor generators on a train, a feature very necessary on multiple-unit stock. The system further allows any motor generator to supply current to the whole train in case of emergency, or the splitting up of the train into sections fed from separate motor generators.

HEATING AND LIGHTING.

The heating circuits, to which we have already made brief reference, are of special interest. Each compartment is provided with four 300-watt heaters, designed for operating direct on the 1500-volt supply.

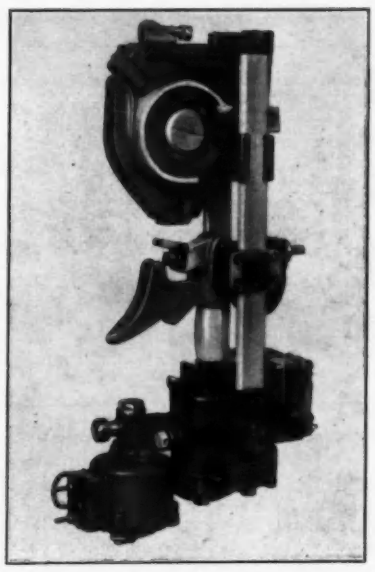


FIG. 14—CONTACTORS

The heaters are insulated for 1500 volts to earth and wound for 750 volts, two heaters being permanently wired in series. Two heating circuits are provided on each coach, and are controlled by switches situated in the guard's and driver's compartments respectively. These switches operate contactors situated in the high-tension chambers. Each local circuit is provided with 1500-volt cartridge fuses enclosed in cast iron containers mounted on the ends of the coaches, while main heater circuit fuses are provided in the inner high-tension chambers of the motor coaches. Special 1500-volt jumpers and plugs are provided for carrying the high-tension supply from the motor coach to the heaters in the trailer and driving trailer cars, and by means of a patented system of interlocked couplers it is rendered impossible to withdraw a coupler at any time when either it is carrying current or is energised at 1500 volts. This safety feature is necessary in order to avoid danger to the shunting *personnel* when making up trains.

It should be noted that the protective system does not depend solely upon de-energisation of the heater circuit contactor, but that mechanical interlocking is also provided so that a jumper can only be withdrawn after the opening of contactors mechanically associated with the coupler sockets. To withdraw a heater circuit jumper it is first necessary to de-energise the train line, thus opening all interlocking contactors. Should a contactor fail to open the jumper remains locked in.

The feed point for the high-tension heating circuit is common with that of the auxiliary circuit and is accordingly subject to the safety interlocking as already described. As a further precaution against failure of a contactor to open the heating train lines are earthed through the main equipment earthing switch whenever the inner high-tension chamber of a motor coach is unlocked.

Lighting is carried out at 110 volts, the supply being taken from the motor generator sets. The circuit on each coach is divided into two main branches, so that either one-half or the full number of lights may be employed. The lighting circuits may be all fed from a single motor generator set, or alternatively may be distributed among the various motor generator sets on the train. Whatever arrangement is employed, however, it is impossible to parallel the motor generator sets. Master control of all lighting circuits is effected from the guard's compartment.

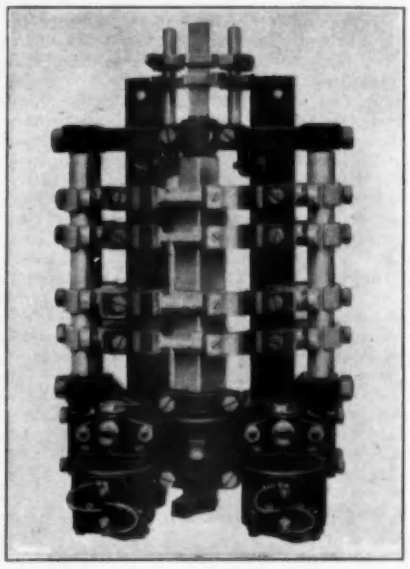


FIG. 15—REVERSERS

Lieut.-Col. Cortez-Leigh, chief electrical engineer to the L.M.S. Railway, and Mr. H. N. Gresley, chief mechanical engineer to the L. and N.E. Railway, were jointly responsible for the complete electrification and the supervision of the equipment during manufacture.

The Iron and Steel Institute.

No. II. (*Conclusion*).*

AT the opening of the meeting on Friday, May 8th, the secretary, Mr. G. C. Lloyd, announced that grants from the Andrew Carnegie Research Fund of the Institute had been made in respect of the year 1931–32 to eight workers. Five of the grants were of £100 and the remainder of £50 each.

The President introduced to the meeting his Excellency Mr. Jan Masaryk, Minister Plenipotentiary for Czechoslovakia, and expressed to him a hearty welcome. The President reminded the members that when they had visited Czechoslovakia last September, Mr. Masaryk's father, the veteran President of the Czechoslovakian Republic, had been good enough to extend his patronage to the meeting, and had also extended the most cordial hospitality to a deputation of the Council at his private residence.

The President also extended a hearty welcome to Dr. Emanuel Valenta, of the Skoda Works, Pilsen, who had travelled from Czechoslovakia to receive the Andrew Carnegie Gold Medal, which was awarded to him in recognition of his researches—which had been carried out with the assistance of the Carnegie Research Fund—on heat and acid-resisting cast irons with high chromium and carbon contents.

Dr. Valenta, in expressing his pride in receiving this coveted award, said that he was happy to be the first Czechoslovakian to be awarded the Carnegie Medal, and no less happy that the distinction was conferred

* No. I. appeared May 15th.

upon a member of the engineering staff of the Skoda Works.

Mr. Frank Bainbridge, to whom the Williams Prize, value £100, for 1930 was awarded, in respect of a paper he had presented entitled "Developments in Fuel Economy at Skinningrove," received from the President the certificate of award, and was congratulated upon his success.

A paper by Mr. V. Harbord on "The Basic Bessemer Process: Some Considerations of its Possibilities in England," was then read and discussed.

THE BASIC BESSEMER PROCESS.

For some years the basic Bessemer process in Great Britain has been almost superseded by the basic open-hearth process, but on the Continent, although the output of open-hearth steel has steadily increased and now exceeds that of basic Bessemer steel, last year over 17,000,000 tons were produced by the latter process. It is generally considered that basic Bessemer steel under similar conditions is cheaper to produce and for certain special purposes gives as good results as basic open-hearth steel.

Very large quantities of basic Bessemer steel are being imported into this country at a price at which we cannot produce open-hearth steel; in view of this and the present state of our industry it would seem desirable to review the position in Great Britain and consider whether under present conditions the basic Bessemer process can compete with the Continent or produce at an appreciably lower cost than the basic open-hearth.

The object of this paper is not to hold a brief for either process, but to compare our natural resources with those of the Continent, in the hope that a discussion will enable us to arrive at the facts, and see what are the possibilities of producing cheap Bessemer steel in this country.

The paper then goes on to consider the reasons for discontinuing the manufacture of basic Bessemer steel in Great Britain and later discusses sites for a Bessemer plant in England, coming to the conclusion that one in Northamptonshire or Lincolnshire would have the best chance of competing with continental manufacturers in Belgium and Luxemburg.

The advantages and disadvantages of the basic Bessemer in comparison with the basic open-hearth process may be summarised as follows:—

Advantages.—(1) Lower labour costs, the number of men employed per ton of output being considerably less.

(2) Considerably lower capital cost of plant. This is partly discounted by larger blast plants being required for the same output of steel.

(3) Lower fuel consumption.

(4) Regular delivery of the ingots to the mill in relatively small quantities, which greatly facilitates the mill operations.

(5) Higher credit for basic slag, owing to its higher content of phosphoric acid and higher citric acid solubility. In some basic open-hearth plants slag equal in citric acid solubility to Bessemer slag is being produced.

Disadvantages.—(*a*) A much lower yield of ingots from the metal charged.

(*b*) Less elasticity in the quantity of scrap which can be used, the maximum quantity being very small. This prevents advantage being taken of fluctuations in the price of scrap as in open-hearth practice, and also necessitates the operation of a larger blast-furnace plant for an equal tonnage of ingots.

(*c*) As all the blast-furnace gas cannot be utilised in the plant, a lower credit must be given for this, and the pig iron costs will be slightly higher.

(*d*) As no coke oven gas would be required for plant purposes, it would not be economical to erect the coke oven plant adjacent to the steel plant unless the surplus gas could be sold to outside consumers.

(*e*) Less control in process of manufacture. For the class of products under discussion this should not be serious, as "off-heats" should not often be made.

In an appendix an estimate is given of basic Bessemer practice based on continental operating costs at several works and, for comparison, the operating costs of a modern continental open-hearth plant with large tilting furnaces, each producing about 2000 tons of ingots per week.

Mr. E. H. Saniter, opening the discussion, said that the basic Bessemer process had been abandoned in this country years ago because it did not pay, and he expressed the opinion that circumstances since that time had not altered the position. He commented upon the author's statement as to the suitability of basic Bessemer steel for such purposes as billets for re-rolling into miscellaneous products, wire rods for common wire-drawing, reinforcement bars, sheet bars, and tube strip, and said that he did not recognise that it was specially suitable for any of these purposes from the point of view of quality, though price might have its influence. Although the author had referred to its use for tube strip, Mr. Saniter believed it was always considered that acid Bessemer tube strip from the United States was the best welding material. Discussing the analysis which the author had given for a basic Bessemer pig iron, he suggested that the author's figure of from 1 to 1¼ per cent. of manganese was inadequate, and that a manganese content of 2 per cent. was necessary, more particularly in view of the not too satisfactory ores from which the pig iron had to be made. In his opinion it would cost 2s. 6d. per ton more to make basic Bessemer pig of suitable composition than to make pig for the open-hearth process. He also commented upon the author's comparison of basic Bessemer and open-hearth costs, and said that the basic Bessemer costs were based on a metal yield of 88·5 per cent., whereas he had learned from inquiries made in Germany that the yield was nearer 85 per cent. If the latter figure was accepted, the author's costs of production of basic Bessemer steel would be increased by another 2s. 6d. per ton. Against that, there was the cheaper pig iron for the open-hearth process, and also in the case of fixed furnaces at any rate, a very considerable reduction of cost owing to cheap scrap. Apart from that, however, if open-hearth steel was made in a furnace, such as that at the Appleby Iron Company's works, described on the previous day by Mr. A. Robinson, there would not be much meat for any basic Bessemer process in this country. No attempt had been made in the paper to deal with the question of yields in the mill, but he ventured to say that from basic Bessemer steel they would not be so good as from open-hearth steel. Emphasising the importance of the commercial aspect of the problem, he said that, accepting the author's figure of £3 4s. 3d. as the cost per ton of ingots of basic Bessemer steel made in this country, it must be remembered that blooms had been delivered on the Tees at £3 5s., so that anyone who was considering the erection of a basic Bessemer plant here must face the problem of dumping from abroad.

Mr. Herbert Scott said it would be very useful to have the views of those who had been connected with an experiment carried out at Ebbw Vale after the war in connection with the production of basic Bessemer steel. He did not think that that experiment had proved successful—to his regret. Discussing the ores used, he said he believed that the physical condition of the Northamptonshire ore was very unsatisfactory during some periods of the year, and particularly in winter, and he had sometimes wondered how the users could get it through the blast-furnace and get anything out of it. In the consideration of the problem, the commercial aspect must be predominant, and he suggested that it might be a good thing if the operatives in the industry could hear, in the atmosphere of such a meeting as that, impartial statements as to the *pros* and *cons* by those who were not directly interested in politics.

Mr. J. Henderson, discussing the author's comparison of basic Bessemer and open-hearth costs, said that the author had assumed 65 per cent. of scrap in the basic open-hearth furnace charge, and the scrap was priced at 50s. per ton, which was the same price as the pig iron, and in that respect the case for the open-hearth process was handicapped. Mr. Henderson suggested that a comparison of the basic Bessemer and the Talbot process would be a straighter comparison. But, assuming that basic Bessemer ingots could be produced in this country at a lower price than ingots of other steel, should we find a market for it in this country, and would the large capital expenditure necessary on the plant be justified by the results? He doubted the accuracy of the author's statement that probably a suitable pig iron could be produced in Northamptonshire at as low a cost as anywhere in the world. Accepting his figure of 50s. per ton, which was round about the figure for basic pig iron in this country it had to be borne in mind that in India, for example, pig iron was being produced at about 30s. per ton. He imagined also that in some districts in China, pig iron could be produced at a very low cost, and the possibilities of very severe competition in both pig iron and steel from the Far East had to be visualised. With regard to the Lincolnshire deposits, the author had stated that they contained less iron than those in Northamptonshire, and that the lime, silica, and iron contents of the beds varied very much in different parts, but by judicious mixing a self-fluxing burden could be obtained; Mr. Henderson pointed out, however, that that was so at one time, but it was not so to-day, and that if the beds were worked at anything like their full thickness there was definitely a surplus of lime. With regard to the author's comparison of basic Bessemer and open-hearth costs, he said the wage figure of 4s. 2d. per ton in respect of the open-hearth plant could be achieved, and with the most modern open-hearth plant, it could be reduced still further.

Mr. C. S. Burch, who was appreciative of the vital importance of doing everything possible to reduce the price of British steel, said that although the production of basic Bessemer steel in this country had been abandoned once, there was no reason why another attempt should not be made, having regard to the immense quantities of foreign steel imported.

Dr. W. H. Hatfield, who was anxious to have the two processes judged technically, was surprised that the author of the paper had not presented a complete picture—it was not complete unless the physical chemistry of the basic Bessemer process and of that with which it was compared were dealt with. In all seriousness he suggested that if basic Bessemer plants were to spring up in this country, we should regard it, from the scientific point of view, as an excellent example of "atavism," *i.e.*, a reversion to earlier and less successful types. The author's statement that very large quantities of basic Bessemer steel were being imported into this country at a price at which we could not produce open-hearth steel, was not fair. That was not even a function of the economics of production; it was a matter of selling tactics, and, from what one read in the newspapers, the selling prices of cheap steels from the Continent were such that it was hopeless to approach the matter from the angle from which the author was approaching it. The open-hearth process had a great advantage from the point of view of the quality of the steel produced, because there was much greater control than in the basic Bessemer process and far greater chances of the product being homogeneous and reliable. Therefore, the author should have emphasised quality much more than he had done. In these days, particularly, Britain must stand first for quality, and Dr. Hatfield cautioned British manufacturers against a hasty reversion to a type of steel which, for several reasons, had been discarded.

Mr. Benjamin Talbot (Past-president) was of opinion that English engineers were right when they had placed an embargo upon the use of basic Bessemer steel for practically everything to which a test had to be applied. From that moment they had killed the basic Bessemer process in this country, but on the Continent that course was not adopted, and basic Bessemer steel could be used there for commodities for which we could not use it in this country. He had heard it stated by buyers of that class of steel that it was better for their products than was the basic open-hearth steel, but he did not believe it, because the United States, which made more tubes than the rest of the world put together, did not use an ounce of basic Bessemer steel for that purpose. Commenting upon the author's reference to the cheapness of Northamptonshire iron, he said that the cost of treatment to render it ideal—and it must be so treated if the basic Bessemer process was to be run at the lowest cost and produce the best quality of steel—would cost, perhaps, more than the author had suggested.

Mr. W. J. Spence Thomas was one of those who emphasised the importance of producing basic Bessemer steel in this country. He pointed out that basic Bessemer steel, as produced to-day, was certainly very much better than that produced 30 or 40 years ago, and its suitability for many purposes was well known. According to the figures given in the paper, it was likely that we should be able to supply it for those purposes, and that would be of great advantage to the trade of the country generally. It was all very well to say that it had not been made in this country for 20 odd years, but great improvements had been effected abroad in that period, and British steel makers should not put aside too lightly the possibilities of utilising basic Bessemer steel in order to enable this country to retain some of its export business.

Mr. T. P. Colclough said that, inasmuch as we were suffering from trade depression, and, at the same time, from importation, it was of no use discussing quality. The essential fact was that such steel was being imported to the extent of more than a million tons per annum, and was proving suitable for the work it had to perform. The author had rightly pointed out that England possessed ores of similar quality to those obtained in some districts abroad, and that they could be mined at a lower cost. Was it beyond the wit of an Englishman to put down similar plant, to exercise as much brains and intelligence as his continental competitors and to produce the same quality of steel for our purposes. The continental manufacturer, with similar materials, and mined at a slightly higher cost, had, for years, manufactured steel for the British market at prices which we could not meet.

Mr. T. M. Service, commenting upon the difficulties of tube makers who used basic Bessemer steel, asked whether much of that trouble was due to the use of inferior basic Bessemer steel?

Mr. A. Hutchinson asked whether, in view of the fact that British open-hearth plants were not used to their full capacity because the markets were against us, and bearing in mind the doubt that ultimately we could make the basic Bessemer steel more cheaply than open-hearth steel, it would be wise to erect new basic Bessemer plant? It had been said that the basic Bessemer steel was good enough for its purposes, but the real point was that it was being dumped into this country owing to the commercial position. If that dumping could be stopped, then the open-hearth process would have its chance, and if the open-hearth plants were able to work at full output, we should then find out how far they could supply present users of the basic Bessemer steel with a better quality product at a price not very far above that of the basic Bessemer steel.

Mr. Harbord, in his reply to the discussion, disagreed with the argument that, because the basic Bessemer process had not paid in the old days, it could not reasonably be expected to pay to-day; he pointed out that conditions since the early days had changed entirely, and he believed costs were lower. Dealing with a suggestion that a phosphorus content of 1·9 per cent. in the basic Bessemer pig should be the minimum, he said the continental manufacturers were using pig having a phosphorus content of from 1·7 to 1·9, and were securing satisfactory working regularly. Again, he believed a manganese content of from 1 to 1·5 per cent. was sufficient, but much would depend upon the composition—the sulphur content, and so on—of the ores. Replying to Mr. Saniter's question as to the yield in the blast-furnaces, he said the figure he had obtained from various works on the Continent was 88·5 per cent., and he believed that figure could be attained continuously on a reasonably up-to-date plant. Replying to Mr. Scott's reference to the experiment at Ebbw Vale, he said he did not think that one would expect such reliable results from basic Bessemer plant there as in the districts suggested in the paper. Discussing the condition of the Northamptonshire ore, especially in winter, he said that that was probably a very important factor, and he would like to hear the views of those who were concerned with the working of that ore. With regard to the fact that he had quoted 50s. per ton as being the price of scrap and of pig iron, he said he had obtained the figures from an actual cost sheet, covering a long period, and he considered that that was the fairest figure to give. Perhaps his statement that Northamptonshire pig iron was the cheapest in the world was rather sweeping, as Mr. Henderson had suggested. No doubt, in the East, the labour costs would be lower, although labour cost was a comparatively small factor in the total cost of pig iron in a furnace having a large output. Finally, he said he was sorry to have

neglected the considerations put forward by Dr. Hatfield, but his point was that if basic Bessemer steel was being imported into this country and being used here, why should not we make it ourselves?

The next paper was one by Dr. Rosenhain and Mr. Murphy on "Accelerated Cracking of Mild Steel (Boiler Plate) Under Repeated Bending."

ACCELERATED CRACKING OF MILD STEEL.

This paper described the results obtained from a series of tests on the bending of steel.

Bars of boiler plate steel and of cold-rolled mild steel, when subjected to repeated bending in alternate directions while in contact with various media.

When the bending occurred at intervals of twenty-four hours and the test pieces were continuously immersed during straining and resting in the respective media, visible cracking and complete fracture occurred at earlier stages in tap water and brine, containing 350 grammes of sodium chloride per litre, than in air or in a caustic soda solution, containing 500 grammes of caustic soda per litre. The greatest reduction in endurance—expressed as the number of deflections required to cause fracture—was produced by tap water and might amount to 37 per cent. of the corresponding value in air.

When there was no interval between successive deflections the endurance was the same in all four media and was equal to the endurance of a specimen bent at intervals of twenty-four hours in air. Increasing the resting period from twenty-four to forty-eight hours produced no further reduction in endurance. Intermediate values of endurance in tap water were produced by:

(*a*) Bending at intervals of one hour, with continuous immersion,
(*b*) Bending in tap water, drying, and resting in air, and
(*c*) Bending in air and resting in tap water.

Microscopic examination yielded no evidence of intercrystalline cracking.

A tentative explanation of these results is suggested, based on the idea that a solid corrosion product, deposited in surface fissures while the test piece was resting in tap water or brine, gave rise to concentrations of stress at those points on subsequent bending.

The practical significance of the results is discussed, together with proposals for further investigation.

Dr. W. H. Hatfield, who opened the discussion, recalled that a recent work by Evans and others had established clearly the existence of a film which was produced under certain conditions on steel, and it might well be that the solutions and liquids employed by Dr. Rosenhain and Mr. Murphy, by reacting on this film and breaking it or dealing with it in ways which we could not predict, had had some profound influence in producing the results they had obtained. He looked forward to further communications from the authors in this field.

Mr. J. H. S. Dickenson said he believed the phenomenon the authors had observed was part and parcel of the phenomenon of corrosion fatigue. He believed the facts brought out in the paper were quite new, but the results were very much what one might have expected. Corrosion effects had to be produced while the specimens were actually rotating, and if the speed of rotation had been slower different results would have been obtained.

Dr. N. P. Inglis referred to the failure of some chalk driers with which he had been concerned. These driers consisted of tubes through which steam was passed, and the chalk was applied on the outside, the moisture content of the chalk being about 10 per cent. About twice every shift of eight hours these tubes were struck with a hammer in order to clear the chalk from them, and the tubes had failed within about six weeks; that was unexplained until the paper by Dr. Rosenhain and Mr. Murphy appeared. The tubes were not corroded, but there were some cracks in them, sometimes intercrystalline, but not always.

Major H. O. Wraith, commenting on the fact that the authors had used three liquids for their experiments, viz., tap water—which contained a fairly large percentage of solids—caustic soda and brine, asked if it were not possible that the actions of the brine and the caustic soda were corrosive, whereas the action of the tap water was to deposit solid matter in infinitesimal cracks.

Mr. J. E. Fletcher, consultant to the British Cast Iron Research Association, referred to his experience with some vertical boilers, with dished ends, in which criss-cross lines suggestive of certain forms of stressing were found to occur in places that were influenced obviously by the ordinary boiler water corrosion. On the water side there was evidence of rather rapid erosion or corrosion, and on the outside, *i.e.*, the flame side, there was also rather excessive corrosion at the same point. It seemed to him that occasionally, in very drastically worked boilers, where there was flame impingement on the one side and a certain amount of solid deposition on the water side, action somewhat like that referred to in the paper occurred in practice, leading to corrosion effects, and sooner or later reducing the ability of the plate to resist alternating deformation. In boiler work, of course, the distortion was microscopically small.

Mr. Murphy, replying to the discussion, said there had been no strong opposition to the very tentative suggestion put forward in the paper as to the cause of the phenomenon described. At the same time, the results of supplementary tensile experiments which had been carried out had been such as to raise doubts that the explanation of the phenomenon, given in the paper, was completely true.

A paper by Dr. Gough and Mr. Murphy, entitled "Research on Wrought Iron Chains: The Nature of Defective Laminations in Wrought Iron Bars and Chain Links," was then read and discussed.

DEFECTIVE LAMINATIONS IN WROUGHT IRON BARS.

The fractured surface of a bar or chain link sometimes reveals the presence of one or more laminations exhibiting a brittle "coarsely crystalline" appearance, the remainder of the section having the normal appearance of ductile wrought iron. The authors have made an investigation of this phenomena with the following conclusions:—

The results of the mechanical tests bring out clearly essential differences between the properties of the defective and normal layers. The defective layer has a slightly greater tensile strength and hardness than the normal material, but is chiefly characterised by marked brittleness, shown by greatly reduced ductility in static tensile tests, and particularly by very poor shock-absorbing power under impact loading. When broken under shock the fracture of the defective layer always exhibits a very coarsely crystalline appearance. When a bar made of iron containing one or more defective layers is fractured under bending forces, the degree of brittleness exhibited by the bar, as shown by the experiments, will depend, to a large extent, on the orientation of the streak in the bar. The appearance and characteristics of the defective layer studied in the present tests and those of the "burnt laminations" previously observed by the authors in the links of certain wrought iron chains are so exactly similar as to leave no doubt regarding their identity.

From the chemical analysis and metallurgical examination it is seen that the brittle defective laminations are characterised by:—

1. High phosphorus and silicon contents,
2. Relatively coarse grain size,
3. Large slag inclusions.

The conclusion to be drawn from these results is that the essential difference between the material in the defective laminations and the normal material resides in the relatively impure nature of the former, particularly as regards the phosphorus and silicon contents.

It has been known for many years that high proportions of phosphorus reduce the ductility and impact strength of iron, and it appears to be mainly to this cause that the weakness of the defective laminations is due. The tendency to form large crystals also increases with the phosphorus and silicon contents.

The experiments have therefore been successful in elucidating one of the causes of brittle failure in wrought iron chains, and it is clear that every precaution should be taken in the manufacturing stage to prevent the incorporation of defective layers of the type investigated, whatever be the purpose for which the wrought iron is to be used. For inspection purposes the presence of such defective layers in wrought iron bars can usually be easily detected by a "nicked" test made on the bar. Arising from the results of the present experiments, a new test has been devised and inserted in the recent British Standard Specification for Short-link Crane Chain for the purpose of discovering the presence of defective pilings; preliminary trials have demonstrated the efficacy of this test.

Mr. Percy Jump, opening the discussion, said that the wrought iron makers had devoted considerable attention to the question of higher percentages of phosphorus, and the paper resolved itself into a recommendation for increased care in the manufacture of wrought iron. He was cheered by the authors' statement that most of the chain iron of good quality did not contain defective layers, and he supported the statement, made during the discussion on an earlier paper before the Institution of Mechanical Engineers, as to the danger of employing foreign bastard iron made of a mixture of iron and steel.

Mr. E. W. Colbeck referred to some investigations which had been carried out, as the result of failures of lifting tackle—crane hooks in particular—with regard to the effect of phosphorus in wrought iron, the results of which had confirmed entirely the authors' suggestions. He added that failure due to brittleness had sometimes occurred when there were no defective streaks and no burning. He urged wrought iron manufacturers to devote very particular attention to the problem of phosphorus.

Dr. R. H. Greaves said he had been dealing recently with an iron containing about 2½ per cent. of silicon—just beyond the limit required to eliminate the γ range. A little carbon in the iron would increase that limit; there was carbon in the iron in question, and it was segregated down the centre. As the result of heating a bar to 1000 deg. and cooling in air, there was an extremely coarse grain in the outside low-carbon region, and a great refinement of structure in the centre—practically the converse of the results the authors had obtained.

Professor Henry Louis, Past-President, speaking as one with practical experience of puddling, said he did not believe that anything like 0·4 per cent. of silicon could exist as such in properly puddled iron—or perhaps he should call it "pig boiled" iron. His experience was that the silicon came out very early indeed. A very definite distinction ought to be drawn between silicon present as silicon and combined with the iron, and silicon present as silicate of iron, and therefore intermingled with it; he asked if the authors had attempted to discriminate between the two; he appreciated that the analysis was a fairly troublesome one, but in a scientific paper the problem ought to be thrashed out thoroughly.

Mr. Murphy, replying to the discussion, said that Dr. Gough and himself agreed absolutely that a properly puddled iron would not contain so high a percentage of silicon as was found in the defective layers of the chain dealt with in the paper, and that it was quite safe to draw from the results the inference that the iron which had such a composition had not been properly or completely puddled.

A paper by Dr. A. L. Norbury and Mr. Morgan on "The Effect of Carbon and Silicon on the Growth and Scaling of Grey Cast Iron" was then taken.

THE GROWTH AND SCALING OF GREY CAST IRON.

In the present paper results are given first of dilatometer tests on grey cast irons having total carbon contents between 4·0 and 2·1 per cent., and silicon contents between 1·6 and 7·6 per cent. These tests show that as the silicon content is increased up to 3 or 4 per cent. the growth increases. The tests, however, further show that with still higher silicon contents of over 4 per cent. the growth in irons having not too large graphite flakes decreases to a very small figure. This beneficial effect of a high silicon content is partly due to its action in raising the critical point, and to a greater extent to its marked effect in increasing the resistance to oxidation.

Results are then presented of accelerated growth tests carried out by heating in moist CO_2 at 600 deg., 700 deg., 900 deg., and 1000 deg. Cent., irons having silicon contents between 0·7 and 14·6 per cent. and total carbon contents between 4·0 and 1·0 per cent. The results confirm the above in that the growth increases as the silicon content increases up to 3 or 4 per cent., and then decreases to very small values with high silicon and low total carbon contents. The effects of total carbon content and graphite size are also shown by the results. The increase in the resistance to scaling as the silicon content increases is shown by increase-in-weight figures, micrographs, and photographs. Increasing the silicon content is so effective that growth and scaling may be reduced to negligible quantities even under the most severe service conditions, provided that the silicon content is sufficiently high and that the iron is made in such a way that oxidising gases cannot penetrate below the surface *viâ* large graphite flakes, gas holes, or cracks. It should be pointed out that these irons become increasingly brittle as the silicon content increases, and are not suitable for service conditions where there is rapid local heating and cooling, since under such conditions they are liable to crack.

Results are also given of some heating tests carried out in a mixture of moist CO_2+SO_2, which was found to be particularly severe in its action. Illustrations are also given of growth due to surface cracking. The conclusion is reached that growth is due to three factors:—

(*a*) Graphitisation of combined carbon;
(*b*) Internal oxidation; and
(*c*) Cracking consequent on volume changes setting up stresses which crack the iron if they occur when the iron is in a non-ductile condition.

It is concluded that in high-silicon irons the allotropic changes occur at such high temperatures, owing to the raising of the critical point, that the irons are ductile and do not crack when heated and cooled through these critical points, even though they are brittle at lower temperatures. The effects of total carbon and silicon content and graphite size on these three factors are then discussed.

Professor Sir Harold Carpenter, F.R.S., said that the authors' investigations into the problem of the growth and scaling of cast iron had been so successful that it had been possible to base upon their results certain patents for alloys which he had no doubt would be of great industrial use. The industry was particularly indebted to the Council of the British Cast Iron Research Association for having given the authors permission to publish their results in a scientific form, for they would be very valuable to other workers in the same field. The paper was first rate, and the evidence was presented in a very convincing form. He gathered that the scaling referred to in the title of the paper was really an extreme form of growth at the surface, so great that the cohesion of the material was lost and the material flaked off.

Dr. A. G. E. Robiette congratulated the authors upon developing a most serviceable heat-resisting material which, he believed, would fill a long-felt want. He said he had had experience of its use in furnace structures, and the results obtained had borne out all that they claimed for it. It was used as a supporting structure for the charge in an electric furnace. The material used previously was the so-called low-silicon heat-resisting cast iron, which generally stood up for a period of two or three months at a temperature of about 850 deg. Cent., and after that time the plates were very badly warped and scaled. The new material, however, had been in use in the furnace for more than five months, but it was absolutely immune from growth and its condition was almost as good as when it was first put into the furnace, though it had been used continuously night and day.

Mr. E. W. Colbeck said that the high-silicon grey cast iron was giving very good results indeed in castings of comparatively small section—for example, in stoker links it was more satisfactory than the low-silicon heat-resisting cast irons—but in larger castings there was the possibility of the material being rather more brittle than normal cast iron.

Dr. Norbury replied.

A paper by Mr. Evans, Dr. Reeve, and Dr. Vernon on "Blast-furnace Data and their Correlation, Part II.," was then presented. The authors give the following summary:—

BLAST-FURNACE DATA.

(1) The mathematical expression of Evans and Bailey has been examined in the light of additional data and confirmed, with the modification, however, that the figure for carbon used other than at the tuyeres has been calculated from the gas analyses wherever possible.

(2) Arising out of the examination of over two hundred and twenty furnaces, the relationship between the iron factor and the time of stock descent has been determined with greater precision, and the relation for an individual furnace has been shown to be expressed by a curve of the hyperbolic type.

(3) This implies that after a certain output has been reached, advantages gained by further increasing the output are counterbalanced by increased hearth carbon requirements as expressed by the iron factor.

(4) For the same time of stock descent the hearth carbon requirements as expressed by the iron factor are consistently lower with rich than with poor burdens.

(5) The mean time of stock descent for optimum fuel consumption and output is lower with rich than with poor burdens—that is, a longer period of preparation in the shaft is necessary in the latter case.

(6) The method has been used for:—

(*a*) The analysis of results of individual furnaces with a view to indicating factors limiting the efficiency of operation.
(*b*) The prediction of results of new furnaces.

(7) The most important factor in blast-furnace efficiency is effective contact between ore and gas. This is influenced by the character of the burden, and suggests the necessity of investigation into the most suitable treatment, particularly with reference to the improvement of coke quality and the treatment of the ore.

(8) The importance of the influence of moisture in the blast has been indicated by studies of an individual furnace over a period.

(9) Radiation and external cooling losses in the shaft are higher in the winter than in the summer months, and investigations are desirable as to the advantages to be obtained from insulation.

Mr. Hamilton, discussing the effect of cyanides and alkalies, said that there were large quantities in some blast-furnaces, and some of the older workers had attributed considerable effects to their action. It

seemed to him that so active a reducing substance as potassium cyanide, for example, in a state of vapour at a high temperature, must do something when there were oxides present to work upon.

Mr. E. H. Lewis asked if the authors had found any definite relation between the iron factor and the size of the ore used in the furnace. Again, in furnaces above a certain size, there might be inefficient distribution of the gases going up the shaft. He imagined that in some of the very large furnaces now being built there might be a sort of cone up the centre which did not receive its full share of reducing gas, and that would have an effect upon the iron factor. Referring to the insulated furnace at Wishaw, he said he had been told that it was showing a saving of about ¾ cwt. of coal per ton of iron. There seemed to be a certain optimum rate of driving which it was undesirable to exceed, and there might be some optimum diameter beyond which there was inefficient distribution of gas up the shaft. These considerations seemed to suggest that furnaces should not be unduly enlarged, and that it might be more advantageous to run a larger number of small furnaces than a smaller number of large furnaces.

Dr. R. Lessing pleaded for the use of a blast-furnace coke with a very much lower ash content than was normal, and said he hoped that during or before next autumn there would be an opportunity of testing blast-furnaces using coke with not more than from 3 to 4 per cent. of ash. If it were found that the removal of impurities from the fuel influenced the melting or reduction of the ore to such an extent that fuel costs were reduced, and the driving rate increased, a great step forward would be made.

Mr. F. J. Bailey, who was at one time associated with the work dealt with in the paper, referred to the critical temperature and Johnson's theory, and said that the point which was constantly being lost sight of was exactly where Johnson's critical temperature had to come. He suggested that before anyone tried to develop the theory any further, he should take pains to measure the temperature inside the hearth of the furnace. There were more or less successful tungsten graphite thermo-couples coming on to the market, and he respectfully submitted that the National Federation of Iron and Steel Manufacturers was well fitted to carry on that development and to make measurements with those couples in the bottoms of the furnaces before commencing to measure the other factors. It was admittedly difficult, but in his opinion it was well worth it.

Mr. Evans indicated that, in view of the shortness of time, he would reply to the discussion in writing.

A paper by Professor Bannister and Mr. Jones on "The Sub-crystalline Structure of Ferrite," was presented and briefly discussed, and the remaining papers on the programme were taken as read.

The Machinery of the C.P.R. Liner Empress of Britain.

No. III.*

ENGINE AND BOILER ROOMS.

IN our second article we gave particulars of the arrangement of the main and auxiliary propelling machinery, and described in some detail the steam pipe lay-out and the turbines and gearing with the condensing and feed systems. To-day we continue our account of the auxiliary machinery, and pass on to the details of the boiler installation and the new technical features which are embodied in it.

* No. II. appeared May 15th.

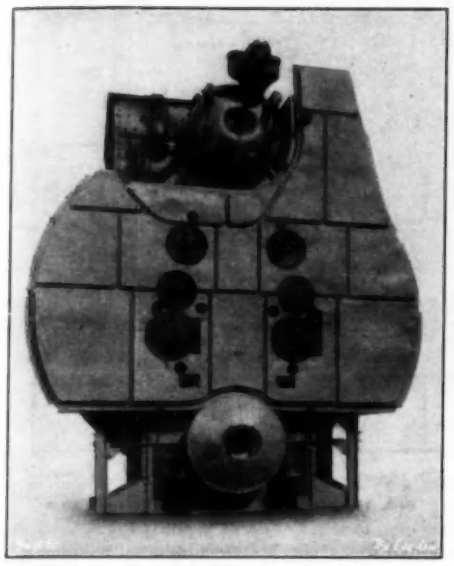


FIG. 13—FRONT VIEW OF JOHNSON BOILER

FIG. 14—INTERIOR OF FURNACE

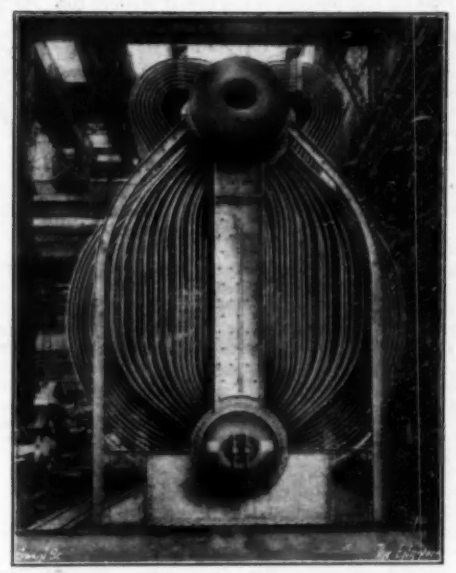


FIG. 15—BACK VIEW OF JOHNSON BOILER

Before leaving the main engine-rooms reference may be made to the main circulating pumps, which are all of the vertical-spindle 24in. diameter centrifugal type. They were supplied by Drysdale and Co., Ltd., of Yoker, Glasgow, and are driven by Laurence Scott protected type variable-speed motors, with a rated output of 150 to 178 B.H.P. Brookhurst starters are provided for these motors. There are two pumps for each of the two inboard condensers in the forward engine-room, and one each for the two outboard condensers in the after engine-room. The auxiliary condenser is placed in the forward boiler-room, and it has a surface of 750 square feet, being complete with an auxiliary hot-well tank, feed heater, along with circulating and feed pumps. Among the other auxiliary machinery in the forward main engine-room we may mention the two 800-kW B.T.H. turbo-generator sets, which are arranged on raised platforms in the wing forward corner compartments. They are supplied with high-pressure boiler steam and exhaust to the main condensers, from which if necessity should arise they can be isolated by means of 27in. Alley McLellan gate valves in the exhaust pipe lines. Other auxiliary pumps we noted included the Carruthers fresh-water transfer pumps and the Drysdale fresh-water and general service pumps. Auxiliaries on the lubricating system include Serck oil coolers and British Separator Vickcen oil purifiers.

The purity of the feed water is determined by two distinct types of salinometers, namely, those made by W. Crockatt and Sons, Ltd., of Glasgow, and the "Dionic" water purity meters, made by Evershed and Vignoles, both of which were fully described in pages 532 and 533 of our last issue. The vacuum in the condenser system is given by Kenotometers, supplied by Brady and Martin, Ltd., of Newcastle-upon-Tyne.

THE BOILER INSTALLATION.

As recorded in our last article, the boiler installation comprises eight oil-fired boilers of the Yarrow type, and one oil-fired boiler of the two-drum Johnson type, all of which are designed for a working pressure of 425 lb. per square inch, with a total superheated steam temperature of 725 deg. Fah. They are arranged in two compartments, the same principle of division of power being carried out as with the main turbines. The six boilers in the after boiler-room normally supply the forward inboard turbines, while the three boilers in the forward boiler-room supply the outboard turbines in the after engine-room. The steam pipe arrangements, which were illustrated in last week's issue, are such, however, that by means of suitable cross-over connections, any or all of the main boilers can supply steam to the ahead and astern turbines in the forward engine-room.

As will be seen from the drawings reproduced in Figs. 17 and 19, the Yarrow boilers which are equipped with Yarrow type superheaters and air heaters, are of the double-flow side-fired type. They were built by John Brown and Co., Ltd., at Clydebank, to designs prepared by Yarrow and Co., Ltd., of Scotstoun. The drums are five in number, including the steam drum, the water drums, and the superheater drum. Both the boiler and superheater drums are hollow rolled steel forgings, with integrally formed ends, and they represent the latest practice in high-pressure boiler work. The upper steam drum has a diameter of 4ft. 6in., with a thickness of over 2in., while the other drums vary from 36in. diameter to 21in. in diameter. The length of the steam drum is over 23ft. Each boiler has a designed generating heating surface of 12,440 square feet, with a normal evaporation of 62,200 lbs. per hr. corresponding to a normal rating of 5 lb. of water per hour per square foot of generating surface. The gases flow through both side banks of tubes and through the large tubular air heater which is placed in a position slightly inclined from the vertical. The heated air then passes down the lagged air spaces behind the side refractory walls, and underneath the bottom of the furnace to the burners. The burners are seven in number, and are of the latest Howden-Wallsend type.

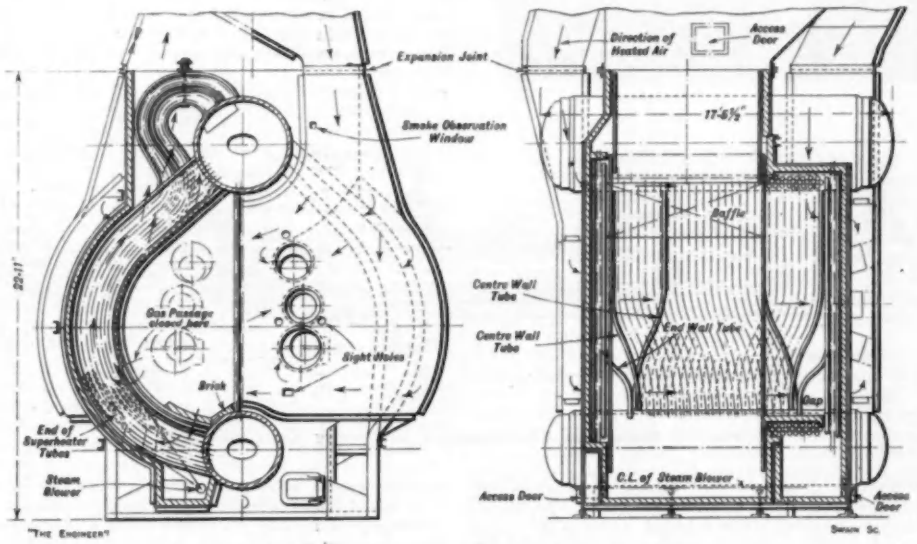


FIG. 16—SECTIONAL ELEVATIONS OF JOHNSON BOILER

The Johnson boiler, which along with two Yarrow boilers is placed in the forward boiler-room, was built by John Brown and Co., Ltd., to the patented designs of Mr. John Johnson, the Chief Superintendent Engineer of Canadian Pacific Steamships, Ltd. It was described in THE ENGINEER of January 9th, but in Figs. 13 to 15 we show external and internal

views of the boiler, along with the sectional drawing, Fig. 16. From the illustrations given, it will be seen that two drums of large diameter, an upper steam drum and lower water drum, are employed, which are supported on the back and the front walls of the boiler in such a manner that free expansion can take place. The upper and the lower drums are interconnected by three banks of tubes, the two outer banks being curved, while the centre bank is straight, At the ends of the boiler there are also tube walls, and these are clearly indicated in Fig. 14. At the front of the boiler six oil burners are arranged in such a way that the flames impinge towards the centre of the cylindrically shaped furnace. Fig. 14 shows an interior view of one half of the furnace, and Fig. 15 a back view of the boiler before the casing was put on. The size of the furnace has been so proportioned that with highly preheated air the requisite travel and time for combustion of the fuel is allowed for. As the furnace is practically surrounded by water tubes, there is a very large area exposed to direct radiation. The design is such that high ratings can be safely employed without any undesirable heating stresses.

The total tube heating surface of the boiler is 6841 square feet, that of the superheater being 3840 square feet, and of the air heater 23,943 square feet. The superheater, the tubes of which will be seen to the left of Fig. 16, is formed of looped tubes, both ends of which spring from the top side of the steam drum. The tubes form part of the outer side walls, and are interspaced with the generating tubes. The superheated steam is delivered from the lower leg of the bend, and is collected in a box-shaped casing within the steam drum, from which it is conveyed by internal pipes to the stop valve. As in the other boilers, the heated air passes from the vertically arranged air heater down the sides and back of the boiler between the inner and outer casings. A very complete series of tests was carried out at Clydebank, which indicated that the Johnson boiler was capable of generating double the amount of steam per square foot of heating surface, compared with standard forms of water-tube boilers worked at ordinary mercantile marine ratings, and at efficiencies of 88 per cent. based on the gross calorific value of the fuel.

During the voyage from Glasgow to Southampton opportunity was taken to test thoroughly the boiler, and an appreciable improvement on the bench trials was noted, this being accounted for no doubt by the minor alterations in design which were made before the boiler was installed in the ship. The normal evaporation of the boiler is 68,000 lb. per hour, corresponding to a rate of 10 lb. of water per square foot of generating surface, while recent tests showed a maximum evaporation of 94,000 lb. per hour, with a rate of 13·72 lb. per square foot of generating surface at an efficiency of about 86·25 per cent. The evaporation per hour per ton weight works out at about 409 lb. under normal conditions and 566 lb. on overload rating, which figures are about double those of standard boilers working at the usual mercantile marine rating. There is no doubt that results of the service performance of the Johnson's boiler will be awaited with the greatest interest by all connected with modern steam production.

We now pass on to deal with some of the boiler auxiliaries which form an important part of the operating equipment.

In all the recent Canadian Pacific liners, a system of tube cleaning and examination has been adopted, which has resulted in the main boilers being run for over six months on end without the necessity of a detailed examination. By this routine, the heating surfaces are maintained at their maximum heat transmission efficiency, and as hand cleaning is done away with, a quick turn round is always possible.

The surfaces of the generating, superheater, and air heater tubes are cleaned by soot blowers, designed and supplied by C. P. Parry, Ltd., of Birkenhead. Fig. 17 shows the arrangement of the blowers in one of the main Yarrow boilers, and its air heater ; while Fig. 18 illustrates the blower itself. In order to be effective the entrained blast of steam and hot gases must on reaching the tube surface be quite dry with a maximum impinging velocity. These essentials are attained by care in the lay-out of the steam supply pipes and drains, and the adoption of correct turbine principles for the design of the de Laval nozzle and the deflecting plates at the discharge nozzle. Each blower is in effect a powerful engine, working at the rate of over 1000 horse-power for the period of about a minute, during which it is in use twice a day. Any soot and ash desposit is at once removed from the tube surfaces and is carried away by the draught, the soot which may collect in corners being removed periodically.

As shown in our drawing, the nozzles of the boiler blowers are so designed that they can be withdrawn into air-cooled housings, when they are not in use. The small hand wheel at the centre controls the admission of steam, while the large hand wheel is the operating wheel, which is used for rotating the jet, through the angles indicated. The air heater blowers are, however, fitted in a relatively cooler part of the boiler, and are designed for a rotary sweeping movement only.

We may remark that the well-laid out and roomy boiler-rooms are cool and well lighted.

Other boiler auxiliaries to which attention may be called include the Cockburn-MacNicoll self-closing stop valves, which are fitted to each boiler. These valves are provided with test levers and an external indicator, which shows the amount of opening of the valve at any time while steaming. In the event of any rush of steam taking place in the opposite direction, the valve immediately closes, and isolates the boiler from the range. Another valve supplied by the same Cardonald firm is the patented high-lift safety valve unit, which is mounted at the end of the superheater drums. The main feature of this valve unit—a drawing of which is reproduced in Fig. 22—is the utilisation of the pressure of the escaping steam to lift the valves by acting on the upper member shown. By this means a high lift is obtained and the valve is given a capacity double that of the ordinary safety valve, thereby allowing the area of the valves and the waste steam pipe to be kept small. The neat arrangement of the three valves in one casing with the baffled relief holes and the easing levers may be remarked upon.

Another safety fitting is the Mumford low-level alarm gear, the working principle of which is indicated in Fig. 19. It consists essentially of a submerged float gear, which is arranged within the steam drum, well below the water line. Should the level of water in the drum fall a determined amount, the float operates, and by opening a needle valve admits steam to a connecting pipe operating an alarm whistle and automatically shuts off the supply of oil fuel to the burners. The design of the trip gear is so contrived that the valve on the oil fuel main cannot be reset to pass oil until the water level in the boiler is reinstated.

Fig. 19 also indicates the arrangement of burners on the boiler front, and above the burners a gauge board is placed with the pressure, superheat, and draught indicating instruments.

The Howden Wallsend fuel units are placed in the centre of the boiler-room between the two banks of boilers. At intervals a brass plate is let into the floor to indicate the position from which the boiler attendant can see all the water gauges. The water level gauges are of the Dewrance ¾in. forged steel type, with screw-down valves operated by chain wheels from below. A feature of this patented design is the water level indicator, which comprises a series of inclined louvres, by means of which the column of water in the glass is obliquely lighted. The result is

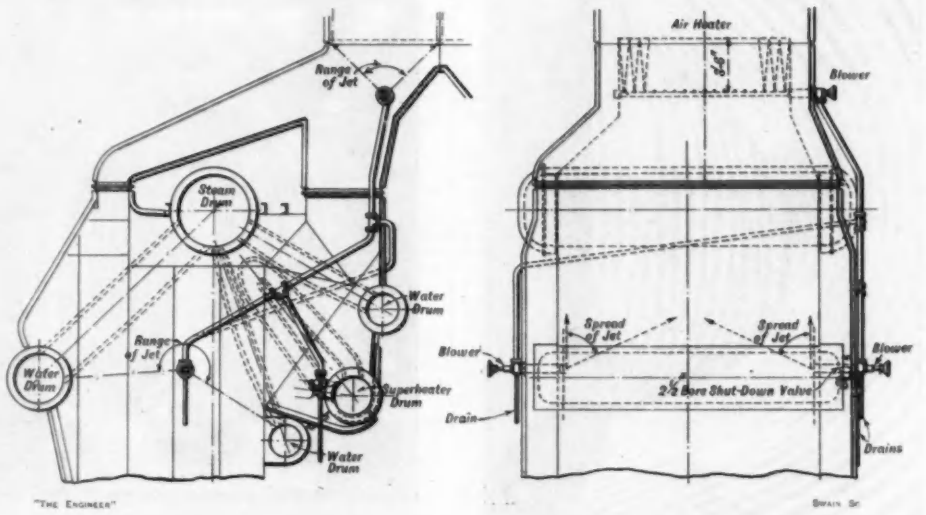


FIG. 17—YARROW BOILER SHOWING POSITION OF SOOT BLOWERS

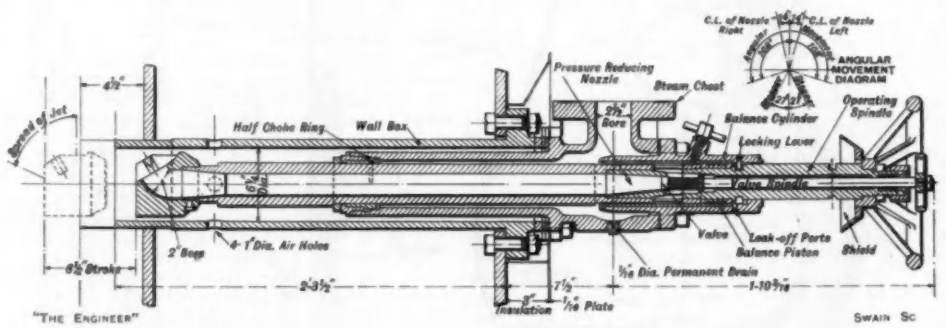


FIG. 18—SECTIONAL ARRANGEMENT OF PARRY SOOT BLOWER

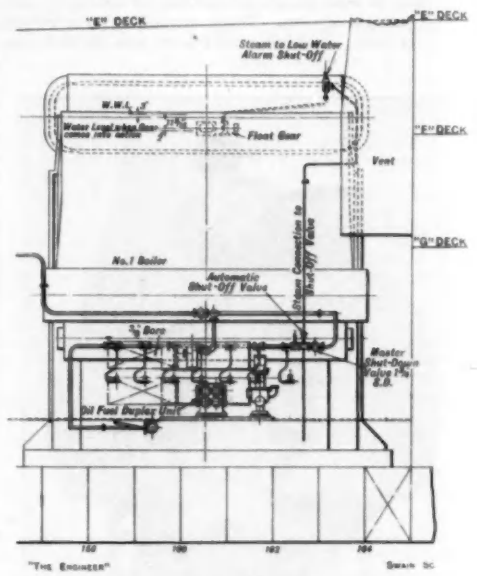


FIG. 19—MUMFORD LOW WATER ALARM

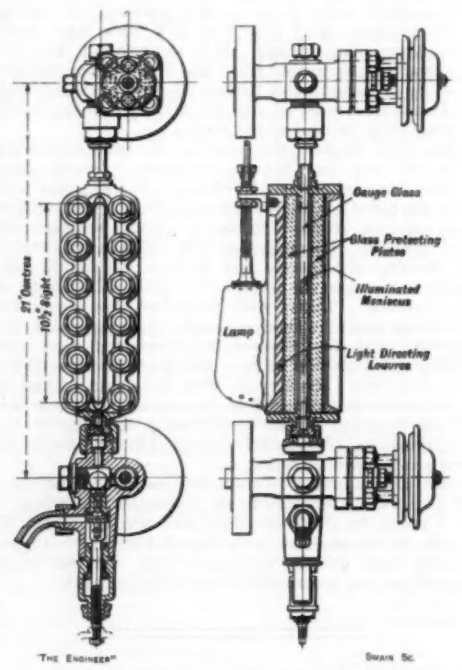


FIG. 20—⅝IN. DEWRANCE WATER GAUGE

that the meniscus is seen from below as a brightly illuminated line, which is distinct in appearance, the clearness being enhanced by the slight movement of the meniscus, which takes place with the boiler in operation, combined with the small movement of the ship. We found that all gauges were easily sighted from the positions on the firing floor. In the case of the two auxiliary 200 lb. pressure marine type boilers, distant-reading gauges of the Kelvin, Bottomley and Baird type are used.

The boilers are designed to work under a combined system of forced and induced draught, which has been designed by James Howden and Co., Ltd., in collaboration with Mr. John Johnson and John Brown and Co., Ltd. The forced draught fans are eleven in

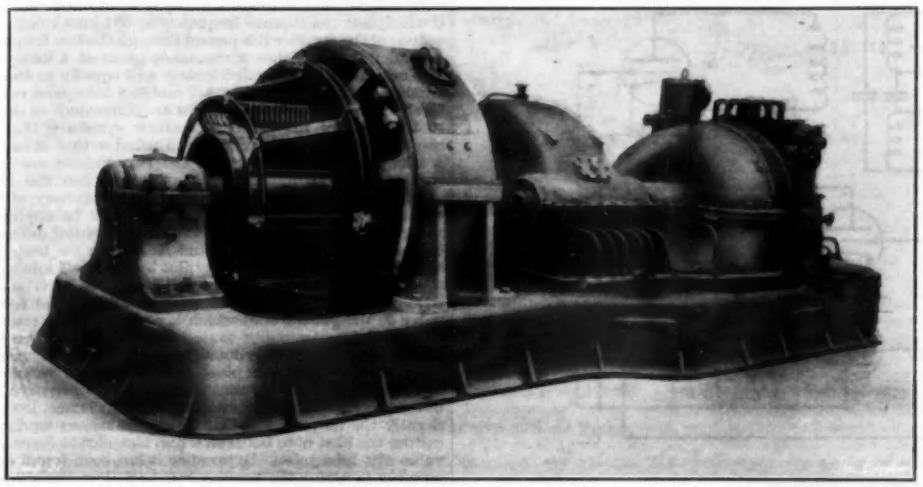


FIG. 21—ONE OF THE TWO 800-KW B.T.H. TURBO-GENERATOR SETS

number, nine of them having a diameter of 63in., and another two a diameter of 57in. The first named fans are used for the main boilers and the smaller fans for the auxiliary boilers. All the fans are of the firm's latest double-inlet high efficiency type, and they are directly driven by Laurence Scott air-cooled "Emcol" motors. The induced draught fans are similarly driven and are of the Howden single-inlet type, with a diameter of 75in. The boiler uptakes and funnels are suitably divided for working with either forced or induced draught, or a combination of the systems.

In order to ensure dry steam being delivered to the turbines, Alexander's Supreme vortex type steam dryers have been fitted to the boilers in the after

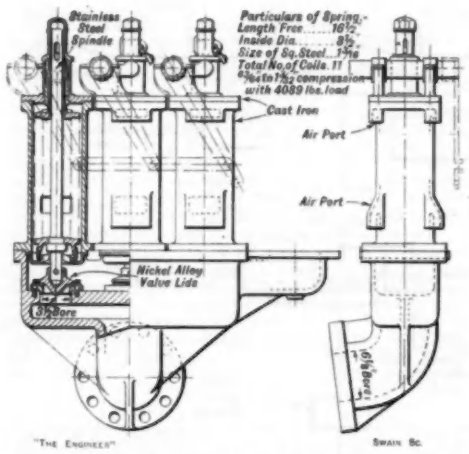


FIG. 22—COCKBURN HIGH-LIFT SAFETY VALVE

room, while in the forward room Tangential steam dryers have been provided. The supply of feed water is regulated by two sets of automatic feed water regulators, one of the Weir-Contraflo pattern and the other of the standard Mumford type. The regulators are mounted one at either end of the steam drums, and during the extensive trials which were recently carried out they worked with entire satisfaction. Marine type "Mono" CO_2 recorders are also installed in the boiler-rooms. Other details we noted included Autoklean discharge strainers on the oil fuel units and on the transfer pump supply pipes to the daily service tanks. The oil level in the tanks is shown by Pneumercator gauges. On the oil fuel suctions there are special valves of the Turnbull Instanter self-closing type. The feature of this valve is that while it may be opened and closed by the hand wheel in the usual way, the action of opening the valve compresses a powerful spring in the upper casing, which is held in position by two toggle links. A connecting lever on the toggle gear has attached to it a wire rope running to the deck, so that in the event of an emergency arising the toggles can be tripped by pulling the rope and the supply of fuel cut off by the spring which forces down the wedge type valves into their seatings.

Both the two main boiler-rooms and the auxiliary generator room are furnished with the Lux patented CO_2 fire-extinguishing equipment.

Other auxiliary pumps and appliances, in addition to those already mentioned, include the hydraulic pumps for the "Brunton" water-tight door controls, and also the pumps connected with the auxiliary boiler feed and condenser systems. The supply of distilled water is obtained from two distillers and evaporators of the Quiggin type, supplied by the Liverpool Engineering Company, Ltd. Hot water for domestic use, both fresh and salt, is furnished by calorifiers of the Royle type with Row patented tubes. They are of the horizontal pattern, and arrangements are made whereby the tubes can be conveniently inspected. The salt water calorifier has a storage capacity of 800 gallons and is designed to heat 12,000 gallons of fresh water per hour from 50 deg. to 150 deg. Fah., when supplied with 60 lb. pressure steam. The salt water calorifier has a 600-gallon capacity and a 10,000-gallon hourly duty when supplied with steam at the same pressure.

AUXILIARY ELECTRIC GENERATOR SETS.

Electrical power for the auxiliary services is supplied by the two B.T.H. 800-kW auxiliary turbo-generators, previously referred to, and by four B.T.H. 450-kW generators, each driven by a Fiat oil engine.

The auxiliary turbo-generators are used when the boilers are under steam, the oil engine driven generators being put into service at other times, such as when the vessel is in port.

Each of the two auxiliary turbo-generators, one of which is shown in Fig. 21, consists of a B.T.H. turbine, having a normal rating of 800 kW at 6000 r.p.m., designed for 375 lb. per square inch gauge initial steam pressure, with 700 deg. Fah. total superheated temperature. The drive is through reduction gearing to a marine type compound-wound generator, with a normal rating of 800 kW, 225 volts, at 670 r.p.m.

The turbines are of the firm's standard impulse type, with stainless steel blading and automatic nozzle control. The nozzle valves are mechanically operated under the control of a speed governor of the centrifugal type, through the medium of pressure oil, which is obtained from a slow-speed valveless rotary pump mechanically driven from the turbine shaft. The pressure oil is also used for the lubrication of the main bearings, and the speed-reducing gearing between the turbine and the generator. The oil system is complete with an oil cooler, reservoir, and oil settling tank.

The generators have natural ventilation and the armature is mounted on a forged steel shaft with an integral half coupling and one journal, the latter being supported by a marine type oil-ring lubricated pedestal bearing. The patented B.T.H. split-coil armature winding with duplex brush gear is designed to maintain good commutation under all service conditions. The terminals are fixed on the top of the generator, and a canopy—which we do not show in the illustration—is fitted over the commutator.

(To be continued.)

THE monthly report of the National Federation of Iron and Steel Manufacturers states that the number of blast-furnaces in operation at the end of April was 78, compared with 81 at the beginning of the month and 151 a year ago. The production of pig iron amounted to 323,200 tons, compared with 357,100 tons in March, and 619,600 tons in April, 1930. The production included 74,000 tons of hematite, 122,800 tons of basic, 97,200 tons of foundry and 16,200 tons of forge pig iron. The March output of steel ingots and castings amounted to 397,400 tons, compared with 500,100 tons in March and 696,100 tons in April, 1930, part of the decline being due to the Easter holidays.

Obituary.

SIR TREVOR DAWSON.

THE news of the sudden death of Commander Sir Trevor Dawson, Bart., R.N., which took place on Tuesday last at his country home, Edgwarebury House, Elstree, was received with widespread regret in engineering and naval circles. Sir Trevor, who at the time of his death was only sixty-five years of age, was many years past an outstanding personality in the Vickers organisation. He was born at Richmond, Surrey, on May 1st, 1866, and was educated for the Navy at the Academy, Gosport. Later, he spent some time at the Royal Naval Colleges at Greenwich and Portsmouth. On July 15th, 1879, he entered the "Britannia" as a cadet, and two years later went to sea as a midshipman in the "Northumberland," of the Channel Squadron. In 1882 he joined the "Swiftsure," which was the flagship of Rear-Admiral Algernon Lynn in the Pacific, and remained in the ship till she returned in the summer of 1885. From sub-lieutenant, young Dawson rapidly rose in rank and soon qualified in gunnery, subsequently being appointed to the instructional staff of the "Excellent." He also served on the "Vernon." In 1892 he was selected for duty as an experimental officer at Woolwich Arsenal, and spent four years at the Royal Ordnance Factories.

It was in 1896 that he resigned from the Navy in order to take up a position as superintendent of ordnance with the then existing firm of Vickers, Sons and Maxim. That period was one of great importance in the development of naval construction and armament, and many ships were built in which scope was found for the enterprise and skill of private contractors. Commander Trevor Dawson took a prominent part in this advance, and he was subsequently

SIR TREVOR DAWSON

appointed chairman of the Vickers Artillery and Shipbuilding Management Board. He continued to occupy a leading position in the Vickers organisation, and at the time of his death was a director of Vickers, Ltd., and Vickers-Armstrong, Ltd., and the chairman or the director of several allied companies. Sir Trevor was knighted in 1909 and in 1920 created a baronet. He was the inventor and designer of many improvements relating to artillery, and the author of several works on ordnance.

In 1901 he became a member of the Institution of Mechanical Engineers, and during the war period served for some time on the Council. He joined the Institution of Civil Engineers as a member in 1908. Apart from his firm's work, Sir Trevor's services were in demand for many Government Departmental Committees, among which we may mention the Home Office Committee on Gas Cylinders, under the presidency of Professor Unwin, on which he served as experimental officer. He was also a member of the War Office Committee on the Accounts of the Royal Ordnance Factories and the Committee on the Investigation of Leading Screws. In 1914 he served on the Admiralty Committee on Oil Fuel. He was a Past-president of the Junior Institution of Engineers and was the first holder of the Institution's Gustave Canet Gold Medal. He belonged to the Royal United Service Institution, and also interested himself in other professional societies. He was keenly interested in athletics and did much to further the pursuit of sport, it being largely by his munificence and enterprise that the Vickers Sports Ground at Crayford was secured. Sir Trevor travelled widely, and as Principal of the Imperial Society of Knights Bachelor and Knight President of the Round Table Club he did much to welcome to this country distinguished guests from the Dominions and from abroad.

Single Side Band Short-wave Wireless Telephony.

A NEW system of radio telephony in which the single side band is applied to short-wave transmission was demonstrated on May 21st at the experimental radio station of Le Matériel Téléphonique at Trappes, near Paris, by engineers of the research laboratory of that company, acting in co-operation with the engineers of the International Telephone and Telegraph Laboratories at the radio station of the Spanish National Telephone Company in Madrid. The results represent the reward of a long search for means of applying the single side-band method, with its well-known advantages, to short-wave radio transmission, a problem that has hitherto presented difficulties that seemed almost insurmountable. The " single side band " system of telephony was first applied some years ago to carrier communication on wire lines, its chief advantage in this connection being that twice as many speech channels can be put into the same total band width as when using direct modulation with both side bands. Since that time it has also been applied with considerable success to radio telephony on long wavelengths, and in particular to the long-wave New York-London commercial telephone circuit, but the method has only just been applied commercially to short wavelengths. Until recently, at any rate, the saving of band width has not been a very important consideration on short wave lengths, as the total band width available at frequencies in the neighbourhood of 10 to 20 megacycles is many times greater than that available on the long wave lengths. Another reason why the system has not been adopted for short-wave working has been the great technical difficulty involved in producing local oscillators, which, while re-introducing the carrier frequency at the receiver would be sufficiently well synchronised with the suppressed carrier at the transmitter.

As regards the advantages of the system, short-wave fading may be divided roughly into two classes: (1) synchronous fading, in which the rise and fall in amplitude of all frequencies throughout the particular band is simultaneous, and (2) selective fading, where the rise and fall in amplitude at the various frequencies in the range considered is more or less random. With synchronous fading, without a local carrier oscillator, the extent of the resulting fade of the audio frequencies is double that experienced when a local carrier oscillator is used, with fading expressed in decibels. Although this is a fairly important advantage, it is not so great as might at first appear, for modern practice in short-wave receiver design is such that the synchronous fading is very largely taken care of by the use of some kind of automatic gain control. The effect of such a device, operated automatically by the carrier amplitude, is to change the gain of the receiver inversely with respect to the signal strength received, so that the resultant speech has a very nearly constant strength. With an efficient automatic gain control, practically the only noticeable effect of synchronous fading —except when it is very deep—is a change in the strength of the background noise. This noise fluctuation may, however, prove quite troublesome to a listener, so that the carrier suppressed system, which halves this noise fluctuation, has an advantage in this respect. It is, however, during selective fading that the suppressed carrier method gives the most noticeable improvement. By the older method the carrier frequency fades out almost completely for intervals of time sometimes approaching half a second, while the side bands remain. The output of the speech detector, being intermodulation products of all the frequencies at the detector input, then shows second harmonics and other terms which may be considerably stronger than the fundamental speech frequencies. The resultant distortion is sometimes quite serious, and this bad effect is most noticeable when any type of privacy system involving a frequency inversion is used.

Another problem which is not elucidated by the single side band method itself, but which, at the same time, is easily solved, is that of increasing the selectivity of the receiver approximately to the theoretical limit. If it is desired to receive the side bands at " commercial " speech quality on the double side band system, it is necessary, on theoretical grounds, to transmit and receive a band width of slightly less than 6 kilocycles. To receive the whole of this band, good stability of the transmitted carrier frequency, and equal stability, accompanied by very accurate tuning, of the receiver is naturally all that is required. At present, the best commercial receiver is designed for a band width of about 8 kilocycles, a margin of 1 kilocycle on each side of the transmitted band being necessary to allow for slight frequency changes in the transmitter and slight changes of tuning at the receiver. There are, moreover, many commercial short-wave receivers in use, of which the band width is nearer to 12 or 15 kilocycles. It is true that this increase of band width does not appreciably increase the receiver background noise level, as the only noise needing consideration is that due to the impulses beating with the carrier, and the impulses spaced more than 3 kilocycles from the carrier produce audio frequencies which can be cut out at a later stage by introducing a low pass filter. Reducing the band width to the theoretical limit, however, may greatly reduce interference due to other stations, and thus make possible closer spacing between adjacent channels. Still another advantage of the single side band system is that the interference due to a side band on receivers tuned to adjacent channels is less noticeable, in general, than the steady beat notes produced by neighbouring carriers.

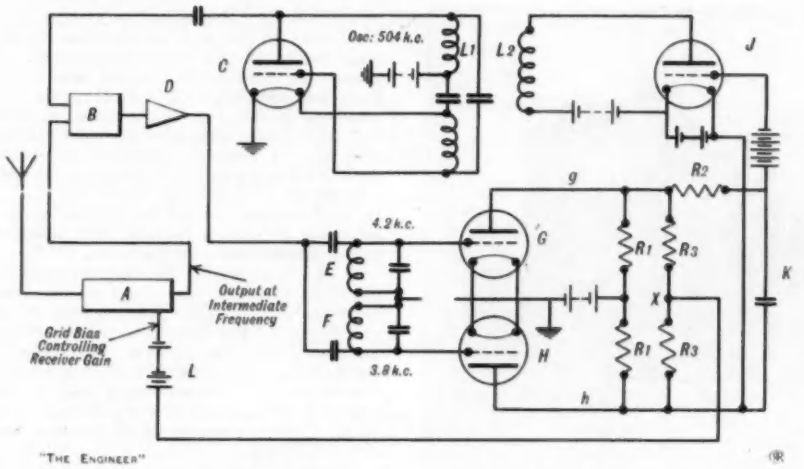


FIG. 1—FREQUENCY CONTROL CIRCUIT

Lastly, during selective fading conditions a further gain in signal-to-noise ratio up to 3 db. is frequently obtained.

As already pointed out, the problem of sufficiently good synchronisation between the suppressed carrier at the transmitter and the local oscillator at the receiver, is one of the major problems involved. The method adopted in the equipment under consideration for overcoming the difficulty is that of transmitting a continuous radio frequency pilot wave in addition to the speech side band, and this pilot is used at the receiver automatically to synchronise the frequency of the local oscillator. The pilot frequency lies some 400 cycles outside the speech side band, which has a breadth of some 3000 cycles, and this avoids any appreciable increase in total band width. The band width of the pilot itself is in the neighbourhood of 30 cycles so as to cater for a maximum sudden fluctuation of ± 15 cycles of the carrier frequency in a period during which the synchronising circuit has not had time to take up a new stable position. In order to avoid reducing the power available for the side band, the peak voltage of the pilot is considerably below that of the side band, and as the energy in the background noise is proportional to the band width, the level of the pilot has been fixed at 20 db. below the side band, so as to have the same signal-to-noise ratio. As the latter ratio must be 10 db. to 15 db. for reasonably good speech, it is evident that the pilot will also be received under conditions in which the background noise does not prevent its utilisation. As regards the time constant of the frequency control circuit, the upper and lower limits are set by the following considerations. From the point of view of commercial speech the maximum deviation in frequency between the suppressed carrier and the local oscillator at the receiver must not exceed 20 cycles per second. The maximum time that the pilot is likely to fade out due to selective fading is about half a second, during which time the local oscillator must not drift more than 20 cycles per second from the suppressed carrier frequency. This fixes the upper limit for the rate of frequency control at 40 cycles per second per second. The lower limit is given by the maximum rate of drift of the suppressed carrier frequency which, in modern transmitters, will not exceed 10 cycles per second per minute. To overcome the difficulty of these two mutually incompatible requirements, it is arranged that the value of the time constant of the frequency control circuit is automatically changed during pilot fade-outs.

The method used is shown in Fig. 1. The coupling between L_1 and L_2 is less than unity, so that if the plate-filament resistance of the valve J is varied, the effective inductance L_2—the tuning inductance of valve C—will be varied. Actually, the valve J has a low plate-filament resistance, which gives a change of about ± 5 per cent. using a mean frequency of 500 kilocycles. The method of control of the valve J is as follows. The portion A of the diagram represents the high-frequency amplifier, first beating oscillator, first detector, and first intermediate amplifier of the receiving set. The resulting output at 500 kilocycles is applied to the rectifier B in combination with a little of the output of the synchronised oscillator C which sets the average frequency at 504 kilocycles. The output of the rectifier B is passed through the low-frequency amplifier D, which has a resonance point at 4 kilocycles. The output of D is coupled loosely and equally to the two circuits E and F, tuning to 4·2 and 3·8 kilocycles respectively. The latter tuned circuits are connected, as shown, to the grids of the balanced rectifier system G H. The resonance curves of E and F are adjusted so that at exactly 4 kilocycles the losses due to the two circuits are equal and at a value of about 8 db. greater than the losses at the resonance points. If, then, the frequency of C is exactly 504 kilocycles, equal voltages will be applied to the grids of E and F, thus giving zero potential difference between the two plates of G and H. When the frequency at C differs from the incoming pilot by exactly 4 kilocycles, the potential difference between the plates of G and H is applied between the grid and filament of the control valve J, the plate coil of which is coupled to the resonant circuit of C. Assuming that, for some reason, the beat note between C and the pilot signal becomes slightly greater than 4 kilocycles, the plate current of the rectifier G will exceed that of H, thus increasing the negative grid bias on valve J, raising its resistance, and, hence, lowering slightly the frequency of C, and by this means tending to restore the beat note between C and the pilot to its original value of 4 kilocycles. In practice it has been found easily possible to cause the oscillator C to follow variations of the pilot signal amounting to plus or minus 5 kilocycles, the resulting beat note never differing by more than 20 cycles from the normal value of 4 kilocycles. The diagram —Fig. 1—also explains how the time constant is introduced into the frequency control circuit. The resistance R-2 is in the neighbourhood of 5 megohms, and condenser K about 20 microfarads, giving a time constant of 100 seconds between impulsive voltage fluctuations across G H and the grid-filament of J.

In practice it is, of course, impossible for the characteristics of valves G and H to be exactly similar; in other words, if the plate currents are exactly equal for one particular case in which the voltages across E and F are equal and at a certain level, the outputs of the rectifier valves will not balance exactly when the voltage level on the grids is altered, although these two voltages may still be equal. Further, if exactly similar valve characteristics were obtainable, the exact balance condition between the two plate currents could never be used in practice. Some voltage difference is always necessary between G and H in order to give the desired frequency change on the oscillator C. If the frequency remains unchanged but the level of the pilot signal is increased, as occurs during fading, the potential difference between g and h will be increased correspondingly, with the resulting tendency to change the frequency of C; *i.e.*, the frequency of C will depend to some extent, not only on the frequency of the pilot signal, but also on its amplitude. To overcome this difficulty, due to the above two causes, an automatic gain control has been added. It is only necessary for a potential difference corresponding to the amplitude of the pilot signal—and not its frequency—to be used to control inversely the gain of the receiver in such a way that a very small change in this potential difference makes a considerable change in gain. To achieve this result in the circuit of Fig. 1 the resistance R-3 is added, and the potential of the mid-point X will be the average between that of g and that of h.

When the beat is in the region of 4000 cycles, therefore, at which point g and h change inversely and almost equally with frequency change, the voltage at X will depend almost

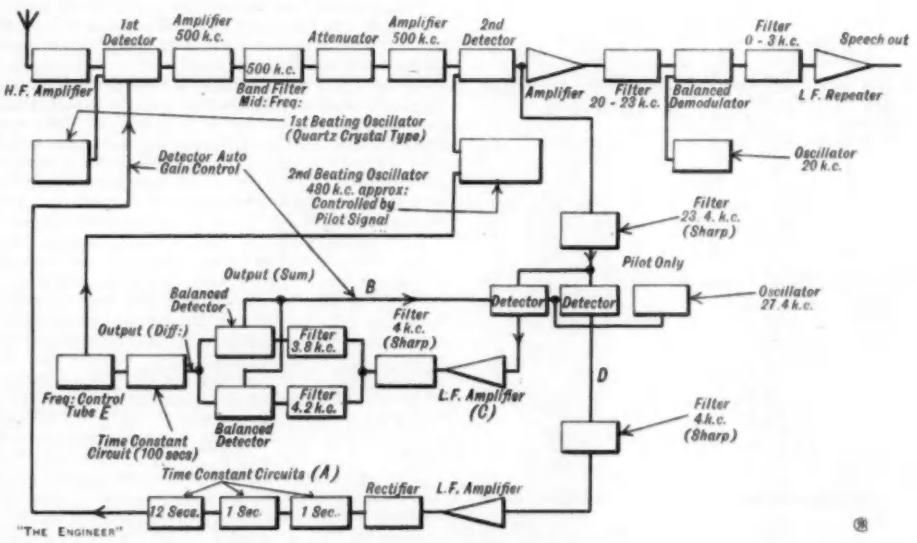


FIG. 2—ARRANGEMENT OF RECEIVER

entirely on the amplitude of the pilot and not on its frequency. The point X is connected to the battery L, which is used more or less to counterbalance the anode voltage of the rectifier valves, thus providing a suitable controlling grid bias for one or more valves of the receiver. By this means, when the pilot signal changes from a value only just above the noise level up to a level of 60 db. above this point, the 4 kilocycle volts applied to the grids by E and F only change by about 10 per cent. The time constant of this automatic gain control circuit is made short enough to follow the most rapid type of fading met with in practice, except, of course, the very rapid fading of more than twenty periods per second, which sometimes occurs, but which is usually small in extent. A suitable value for this time constant has been found to be about one-twentieth of a second. It is now evident that it is only when the pilot falls below the noise level that continuous control of the local oscillator is lacking. Taking the case when the pilot signal is reduced at the transmitter by 20 db. below the peak value of the side band, and when conditions are such that the resulting signal-to-noise voltage ratio of the speech is in the neighbourhood of 3—a minimum value for a commercial circuit—the pilot at the receiver has rarely been found in practice to fall below the noise level for longer than one-tenth of a second, and as far as is known never longer than half a second. The time constant of the frequency control circuit, made up of the resistance R-2 and condenser K, is sufficient to maintain the frequency of the oscillator C well within the required limits during this worst case of fading, lasting half a second.

The receiver is shown in general outline in Fig. 2. It is clear that an ideal single side-band receiver should take account of the accurate frequency control available to reduce the band width passed by the speech circuits to the theoretical minimum of about 3 kilocycles. This can be done most conveniently by using the triple detection type of receiver, the first intermediate frequency being in the neighbourhood of, say, 500 kilocycles, and the second intermediate frequency in the region of 50 kilocycles. The first beating oscillator is controlled by a crystal, the second oscillator being controlled automatically by the pilot signal in such a way that the resultant second intermediary frequency never varies by more than 20 cycles. The band filters at 500 kilocycles have a margin of plus or minus about 4 kilocycles in addition to the width of the side band plus pilot, thus giving a total band width of about 12 kilocycles; the final and high degree of selectivity being obtained by a band filter at the second intermediate frequency—50 kilocycles. As the side band frequencies at this stage have been properly stabilised, this second band filter can be accurately adjusted to cut off at exactly the points required to pass the side band only. The receiver actually used in the tests described here is of such a design that the second intermediate frequency is, however, in the region of 20 kilocycles rather than 50, merely because 20-kilocycle apparatus was immediately available. The next consideration in designing the complete receiver is the question of eliminating, as far as possible, the fading of the output speech. As already explained, short-wave fading may be divided roughly into two classes: synchronous and selective. During selective fading, in general, the average level throughout the whole side band does not change considerably and the gain of the receiver, therefore, should remain constant. When, on the other hand, synchronous fading appears, it is necessary to change the gain of the receiver inversely and automatically to compensate this. To minimise both the short period selective fading and the synchronous fading of longer period, two automatic gain controls are used, one of very short time constant for the pilot channel only, and the other having a time constant in the neighbourhood of 30 seconds or more for the speech and the pilot channel

This type of smoothing is not, however, perfect as the assumption that the synchronous and selective types of fading have different time periods is by no means always true. The constants are not in every case of the optimum values, but are determined by the apparatus that was immediately available. The action of the automatic gain controls consists simply of a rapid increase in grid bias voltage on a detector or amplifier in the earlier stage of the receiver whenever the D.C. output of the final detector to be controlled exceeds a predetermined limit. Such a change in grid bias reduces the gain of the valve in question until the final level is again at the correct value. In each case, between the output detector and the valve of which the gain is being controlled, there is inserted a time constant circuit of a value suitable to the particular function desired. The circuits A shown in Fig. 2 are built up in three sections in order to give a correct curve of output voltage against time, an arrangement which is more suitable than can be obtained with a single section. The gains of the various detectors and amplifiers are adjusted so that the chief component of background noise in the final speech output is due to the grid circuit of the first high frequency amplifier; and the antenna is such that, except under unusual circumstances, the chief component of this first grid noise is caused by atmospherics. This also applies to the circuit of the pilot channel. The gains are such that, when no signal is being received, the static under conditions of minimum strength is beginning to affect the frequency control valve and also the two automatic gain controls. It is of no advantage to increase the gain beyond these limits, and it is also evident that this arrangement gives the best possible signal-to-noise ratio obtainable with the particular antenna used and under the given transmission conditions.

A simplified diagram of the transmitter used in these experiments is shown in Fig. 3. The problem was to evolve a transmitter giving distortionless single side-band speech with sufficient stability, but using, as far as possible, the existing double side-band equipment, and it will be seen that the change-over from double to single side-band working can be carried out with little difficulty. The single side band is obtained by modulation in three successive stages. The first two are at 19 and 250 kilocycles respectively, the modulators being balanced in each case. The side bands are selected by appropriate filters. For the final modulation the existing harmonic generator of the transmitter is employed with the negative grid bias increased to a point such that, within certain limits, the voltage in the output harmonic is linearly proportional to the grid voltage. When the side band output of the second balanced modulator is applied to the harmonic generator grid this latter valve gives the second harmonic and acts as a modulator at the same time. This third modulator, consisting of a single valve, is not balanced, but a sufficient suppression of the carrier and the unwanted side band is obtained by the selectivity of the remainder of the transmitter increased by sharply tuned circuits. This type of transmitter circuit has been found to work quite well in practice.

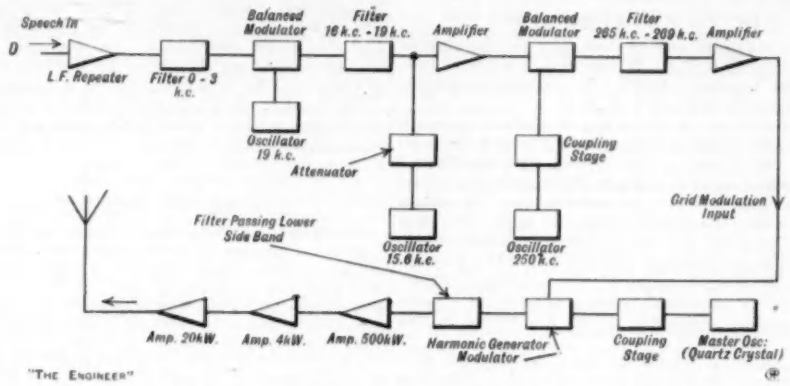


FIG. 3—ARRANGEMENT OF TRANSMITTER

During the period from April, 1930, to March, 1931, single side-band tests were carried out over the following three links:—(*a*) Buenos Aires to Madrid; (*b*) local tests at Madrid, Pozuelo to Grinon (80 kiloms.); (*c*) Madrid to Paris. During the tests the correct synchronising action never ceased for periods longer than about a quarter of a second, and the re-supplied carrier frequency never differed by more than 6 cycles per second from the suppressed carrier. The received speech was always as good as that obtained from the double side band, and very definitely better during bad selective fading conditions. In the Madrid–Paris tests a noise-producing buzzer was employed, giving audio frequency energy more or less evenly distributed throughout the whole speech spectrum. The average result from a number of observations showed a gain of 12 db., when compared with the double side-band receiver with the automatic gain control off, and of 13 db. compared with the same receiver with its gain control on. This is evidently equivalent to increasing the power of the transmitter slightly more than sixteen times. The fading on the speech output was in general definitely less than the best that could be obtained with double side-band working with automatic gain control. In fact, from the results so far obtained, it seems that the average fading, when using the present single side-band system, is about half that with the normal double side-band receiver, and during exceptionally bad conditions, the improvement is even greater than this. Rough tests on the improvement of intelligibility showed that when the percentage intelligibility in double side band is of the order of 20, the corresponding figure with single side-band working is usually between 70 and 80. In other words, a change from double to single side band is capable of changing an uncommercial into a good commercial circuit.

Speech was transmitted at regular intervals throughout all the tests, and the results showed a perfectly commercial circuit with good quality throughout the whole period, with no interruption whatever. Throughout the tests, it was unnecessary to touch the receiver at all, except for the preliminary tuning each night, and the results obtained clearly showed that a system of single side-band working that is applicable commercially to short-wave links has been evolved. The illustration, Fig. 5, shows the wireless field laboratory at Trappes, whilst Fig. 4 gives a view of the single side-band receiver. The two boxes on the table at the right of the picture contain the additional equipment necessary for conversion from double to single side-band working.

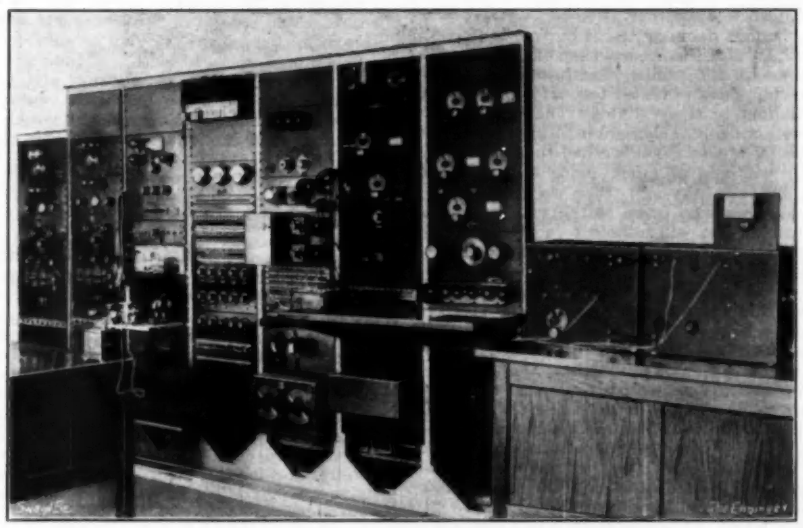


FIG. 4—SINGLE SIDE BAND RECEIVER

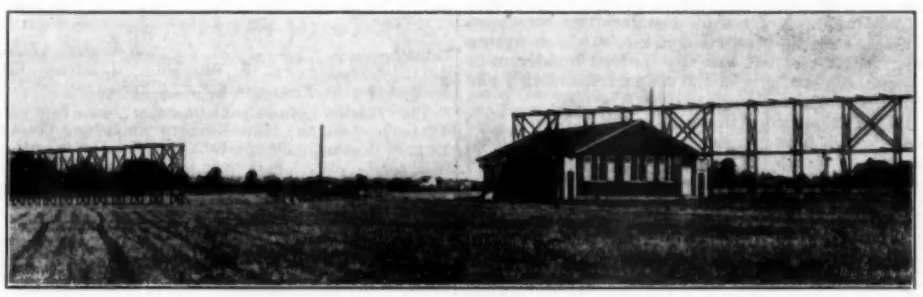


FIG. 5—WIRELESS LABORATORY AT TRAPPES

A NEW ANGLO-SAXON OIL TANKER.—The motor tanker "Cliona," which was recently launched from the Govan Yard of Harland and Wolff, Ltd., is representative of a group of large and fast tankers which are being added to the fleet of the Anglo-Saxon Petroleum Company. The "Cliona" differs from the other vessels of the group in that her machinery is of Harland-B. and W. four-cycle single-acting type, whereas in the other ships Werkspoor supercharged engines are used. Like all the other tankers in the Anglo-Saxon fleet, the "Cliona" is a high expression of the art of tank ship construction. It is a generally recognised fact that the ships of the Anglo-Saxon fleet, size for size, are probably as luxurious as any tankers yet built. The propelling machinery, which is fitted aft, consists of two sets each six-cylinder four-cycle single-acting Harland-B. and W. type engines, which are designed to give the vessel a speed of 12½ knots. The vessel, which is of the three-island type, has been constructed to Lloyd's 100 A1 class for the carriage of about 11,500 tons of petroleum in bulk. She is built on the combined longitudinal and transverse system of framing. Two longitudinal bulkheads and fourteen transverse bulkheads divide the vessel into twenty-one oil-tight compartments as cargo tanks, also oil fuel tanks, pump rooms, cofferdams, motor room, and fore and after peaks. The auxiliary machinery is steam driven.

Literature.

Standard Four-figure Mathematical Tables. By L. M. MILNE-THOMSON, M.A., and L. J. COMRIE, M.A., Ph.D. London: Macmillan and Co., Ltd. Price 10s. 6d. net.

A BOOK of mathematical tables may justly be said to embody the very essence of constancy. In all climes and at all times the logarithm of 2 is, and must be, 0·3010, the sine of 45 deg., 0·7071, and the cube root of 10, 2·1544. In the heavens, as well as on the earth, the hyperbolic cosine of 1 is 1·5431, in all languages the gamma function of 3 is 2·0000, and not even Einstein can make the gudermannian of 4 radians anything else than 1·5342. These things are and must be so, for they are functions of pure number. They are quite unaffected by their surroundings, even by their position in the space-time continuum. As a work of the human mind and hand, a book of mathematical tables is a unique production. In it, and in it alone, can we find factors which are immutable in the face of time, changes of temperature, or Government, and other distracting independent variables. Nevertheless, so strangely contradictory is man, there is probably no subject of scientific interest which has resulted in a greater harvest of books than that yielded by the compilation of mathematical tables.

Since there can be—or, more precisely, since there definitely should not be—any novelty in the figures, a new book of mathematical tables can justify its production solely on the selection of the tables included in it, the convenience with which the tables are arranged, and the value of the non-tabular matter inserted by way of accompaniment to the tables. On all three scores our respect is commanded by the new book of four-figure tables which has been prepared by Mr. Milne-Thomson, Assistant Professor of Mathematics at the Royal Naval College, Greenwich, and by Dr. Comrie, the Superintendent of his Majesty's Nautical Almanac Office.

No significance, we gather, is to be attached to the fact that the first name on the title page is that of a mathematician and the second that of one on whose labours grizzled sea captains, hard-bitten prospectors, and other eminently practical folk rely for the satisfactory conduct of their affairs. The order of precedence, with a finely inconsistent touch, was decided by the spin of a coin. Yet we feel that the book is one which will appeal much more to the mathematician and the physicist than to the engineer. For one engineer who takes to the volume, we can see a thousand who will adhere to their slide rules. They will not do so because of conservatism or lack of intelligence, but because the slide rule, in spite of its restrictions and limitations, gives them all the information they require in the ordinary course of their work. Should they encounter a hyperbolic trigonometrical function, if they have to face some problem in the theory of probability, should they be called upon to deal—as, in truth, they may very well be at a moment's notice—with the interesting function known as the inverse gudermannian, they will no doubt delegate the handling of them to someone who has made a special study of these things. To that someone Mr. Milne-Thomson and Dr. Comrie's book of tables will prove of inestimable value.

The compilation of mathematical tables provides an interesting study in expediency. Take, for example, a table of logarithms. In astronomical and some other calculations, as is well known, seven-figure logarithms are commonly employed in order to ensure the necessary degree of accuracy in the results. For many other purposes, and notably for practically all engineering calculations, four-figure logarithms give sufficient accuracy. But if we were asked to say what was the probable degree of accuracy of a result calculated by means of a table of four-figure logarithms, what would be our reply? The answer is that the accuracy depends upon two factors, the precise nature of the calculations and the principle followed by the compiler of the logarithmic tables in dealing with the fourth figure. No logarithm, except that of 10 and its multiples, can be expressed completely by four significant figures after the decimal point. The fourth figure must therefore be a rounded figure. The common principle followed is to round the fourth figure upwards if the fifth figure is greater than 5 and downwards if it is less than 5. Usually no indication is given of the direction in which the rounding off has been made in any particular logarithm. It may therefore quite well happen that in a string of multiplications and divisions we may quite unwittingly use logarithms all of which have been rounded off in one direction. We can never be sure that the rounding off of one logarithm will cancel the rounding off of another. We can therefore never be sure of the degree of accuracy of our result.

Several attempts have been made to overcome this defect in four-figure logarithms. We like the method adopted by the authors of these new tables, because it tells us not only the direction in which the figures have been rounded off, but gives us a workable indication of the amount by which they have been rounded. The logarithms—and also the figures in all the other tables in the book—are entered either with a high dot—3010˙—or a low dot—4314.—or no dot—3802—after the fourth figure. A high dot signifies that on the average the fifth figure would be +3, a low dot implies that on the average it would be −3, and no dot indicates that on the average it would be zero. We can therefore collect the dots and, treating them as +3 or −3 in the fifth place, make an allowance for the rounding off of the fourth figure in a manner which on the average will remove much, if not all, the uncertainty concerning the last one or two figures in the result of our calculation. Take, for example, the following working which the authors give:—

$$1\cdot109^3\times\sqrt{1\cdot309}\times1\cdot646\times3\cdot69.$$

If the dots are neglected, as they may be, the answer by logarithms is 9·473. If the dots are taken into account the answer is 9·478. The correct answer to five significant figures is 9·4781.

There are other novel features in the arrangement of the tables concerning which much might be said. There is, for instance, the system of proportional parts, which is used to replace the customary mean difference columns of the ordinary tables. By means of this system the interpolation is applied to the difference between any two adjacent entries in the tables, and is not obtained in the form of the average interpolation over a range of ten adjacent entries. The table of proportional parts is printed as a loose insertion and is applicable to all the tables in the volume.

The tables included in the book are such as will appeal to the general mathematical worker. There is no very obvious omission except perhaps a table of $\log_e \sin\theta$ and trigonometrically similar functions, with θ expressed in radians. Expressions of such a form can, however, be readily evaluated by combining two of the tables in the book, namely, that showing logarithmic trigonometrical functions in radians to the base 10 and that showing multiples of 1/M the reciprocal of the logarithmic modulus.

Two tables not usually included in books of this type are tables of addition and subtraction logarithms. In certain calculations we are presented with two relationships of the type $\log a=A$ and $\log b=B$—where A and B are known numbers—and are required to determine $\log(a+b)$ or $\log(a-b)$. The ordinary process would consist of determining a and b from a table of antilogarithms, adding or subtracting them, and then finding the logarithm of their sum or difference. With the help of addition and subtraction logarithms the work can be carried out much more readily. We subtract B from A and get C. We then find the number, D, entered against C in the table of addition—or subtraction—logarithms. Then $\log(a+b)$—or $\log(a-b)$—will be A+D—or A−D. The process is based on the fact that $\log(a+b)=\log a+\log(1+b/a)$ and that $\log(a-b)=\log a-\log 1/(1-b/a)$.

The book closes with a section giving lists of derivatives, integrals, expansions in series, the binomial coefficients, prime numbers—up to 4051—and certain mathematical constants, together with notes on approximate integration, algebra, trigonometry, mensuration, and the solution of differential equations. As engineers we amuse ourselves at times by considering what tools we would select if we knew beforehand that we were about to be cast away on an uninhabited island. A mathematician in similar circumstances could easily make a greater mistake than by choosing this book as his sole companion.

Acoustics. By G. W. STEWART, Ph.D., and R. B. LINDSAY, Ph.D. London: Chapman and Hall. Price 25s. net.

THE subject of acoustics was, until comparatively recently, a sub-heading in the Department of Physics, but, of late years, it has developed, like many other aspects of physical science, into a highly specialised subject, with a vast and classified literature. This branch of science has been studied from every conceivable point of view, physically, mathematically, architecturally and physiologically. It has direct and important application in war and navigation, in mechanical engineering and in wireless transmission and reception. Not only is the architect concerned with the acoustic properties of his buildings from a design point of view, but the modern builder must understand something of the sound transmitting and insulating properties of the materials he uses.

It is a curious thing that striking progress has been made in all branches of acoustics save the most important of all. Physiologically, the theory of hearing is still in complete chaos. Its mechanism, its physiology and its pathology are still very largely matters of guesswork. Deafness, in its many different manifestations, still defies treatment of a specific kind and, consequently, still remains as a potential gold mine for exploitation by quacks.

One of the most discussed branches of the subject is that concerned with the transmitting power of different media and particularly sub-aqueous sound transmission. In its relation to sound-ranging, much valuable work in this branch was carried out in England during the war by such pioneer workers as Sir William Bragg and Professor F. Lloyd Hopwood. The architectural aspect of the subject has, of course, received a lot of attention and interesting oscillographic studies have been made by Zenneck, Linck, and others on the reflection of sound by walls and other structures.

The volume under notice is a text-book, and, as such, it is well written and fills a definite requirement. Fundamental principles are well and clearly explained and each chapter is followed by a valuable set of examination questions and examples. It was written by two American physicists, and we cannot help remarking on the comparative paucity of European references—a defect which so often characterises American scientific literature.

The mathematical treatment of one or two important aspects of the subject, such as acoustic filtration, is developed at some length in a few useful appendices, which also contain handy tables of acoustical data and absorption coefficients; but the most attractive chapter is the first, in which the fundamental theory of the properties of acoustic waves is discussed.

The book is recommended to all students of physics and others who are practically interested in acoustics in any specific connection.

SHORT NOTICES.

The Mechanical Properties of Wood. By G. A. Garratt. London: Chapman and Hall, Ltd. 1931. Price 17s. 6d.—This volume, which has been written primarily as a text-book for students of forest utilisation and wood technology, opens with some fifty pages descriptive of testing procedure of an elementary nature but useful in particular application to timbers. The next section is devoted to the defects which may be found in timber—principally of American growth—and their effect on strength and durability. In this connection the effect of the rate of growth is considered, and it is suggested that summer-cut timber need not be less durable than that felled in winter. This is a long section occupying a hundred pages, and is followed by two comparatively short chapters on safe working loads. The remainder of the book, which amounts to some eighty pages, is devoted to the methods of testing employed in the Forest Products Laboratory of the U.S. Forest Service. There is a fund of information in the book, but it applies principally to American woods.

Molesworth's Pocket Book of Engineering Formulæ. Thirtieth edition. London. 1931. E. and F. N. Spon. Price 6s.—It is nearly seventy years since Sir Guilford Molesworth first collected and published his "useful formulæ and memoranda for civil and mechanical engineers." At that time and for a good many years afterwards, his Pocket-book stood almost alone and rapidly became the familiar friend of engineers. It is greatly to its credit that it still holds its place in face of the competition of younger rivals, and that even amongst men of the present generation it is well known. But constant revision is necessary. Every year brings something new in some field of engineering. Tables which were accurate and comprehensive a few years ago have fallen out of date, new developments have taken place, new discoveries have been made. To keep pace with progress and yet to avoid the growth of the familiar volume to an inconvenient size is no light task, and we congratulate both the new Editor, Dr. A. P. Thurston, and the publishers on the success attained. "Molesworth" is still a pocket-book in fact as well as in name; may it so remain.

BOOKS RECEIVED.

Directory of Clayworkers, 1931. London: The *British Clayworker*, 43, Essex-street, W.C. 2. Price 7s. 6d. net.

Jahrbuch der Schiffbautechnischen Gesellschaft. Vol. 32, 1931. Berlin: Vetter and Co., S.W. 68, Neuenburgerstrasse 8.

The Aneroid Barometer and Altimeter. By R. H. Field. Ottawa: The Department of the Interior, Canada. Price 10 cents net.

A Manual of the Slide Rule. By J. E. Thompson. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 5s. net.

Dictionary of Welding Terms—English, Russian, German. Berlin: V.D.I. Verlag G.m.b.H., Dorotheenstrasse 40, N.W. 7. Price 2 marks net.

Illustrated Encyclopædia of Motor Car Parts and Technical Terms. London: The Temple Press, Ltd., 5–15, Rosebery-avenue, E.C. 1. Price 6d. net.

Elementary Technical Electricity. By L. T. Agger. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 3s. 6d. net.

An Outline of the Universe. By J. G. Crowther. London: Kegan Paul, Trench, Trubner and Co., Ltd., 68–74, Carter-lane, E.C. 4. Price 12s. 6d. net.

"Electrician" Annual Tables of Electricity Undertakings, 1931. Edited by L. F. Shapland. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 10s. net.

The Empire Municipal Directory and Year Book, 1931–32. London: The Sanitary Publishing Company, Ltd., 8, Breams-buildings, E.C. 4. Price 12s. 6d. net.

Forty-third Annual Report Incorporated Swansea Exchange. Swansea: The Incorporated Swansea Exchange, Royal Metal Exchange, Swansea. Price 3s. 6d. net.

The Empire Forestry Handbook, 1931. Edited by Fraser Story. London: The Empire Forestry Association, Grand-Buildings, Trafalgar-square, S.W. 1. Price 3s. 6d. net.

Laboratory Studies of Sludge Digestion; Bulletin No. 30. By A. M. Buswell and S. L. Neave. Urbana, Illinois: Department of Registration and Education, State of Illinois, U.S.A.

Natural Trigonometric Functions to Seven Decimal Places for Every Ten Seconds of Arc. By H. C. Ives. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 45s. net.

Automobile Engines: In Theory, Design, Construction, Operation, Testing, and Maintenance. Vol. I. Second edition. By A. W. Judge. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 4s. net.

Railway and Road Matters.

THE President of the Institute of Transport for 1931–32 is to be Mr. Frank Pick, managing director of the London Underground Railways. Mr. Pick will take office on October 1st.

THE National Union of Railwaymen reports that at the end of last quarter its membership was 334,835, an increase of almost 22,000 during the twelve months. Between 1925 and 1928 the union lost 90,500 members. In the last two years there has been an increase of about 26,800.

OWING to ill-health, Mr. W. Cleaver has resigned from the position of Docks Engineer, Newport, Great Western Railway. Prior to the absorption by the Great Western, Mr. Cleaver was the chief engineer of the Port Talbot Railway. He was an enthusiastic supporter of the Permanent Way Institution. Mr. H. C. Harrison, divisional engineer, Newport, succeeds Mr. Cleaver in charge in the Newport, Barry, Cardiff, and Penarth Docks, but has his office at Barry. Mr. S. A. Blackall, now divisional engineer, Oswestry, goes to Newport to follow Mr. Harrison, and Mr. H. A. Alexander, at present the assistant divisional engineer at Neath, replaces Mr. Blackall.

FROM July 20th great improvements will be made by the Great Western Company in the running of some of its local trains. Although no reason for the change has been offered, it may be assumed that it is done to combat road competition. Examples of thirteen instances have been given in which the time of the throughout journey has been reduced by from ten to as much as twenty-six minutes and the overall speed increased, in many cases to 26 m.p.h. The accelerations have, further, made connections with earlier trains at junction points. In the aggregate 2340 minutes will be saved by the quickening up.

THE new station at Cape Yard Sidings, which has been erected by the Great Western Railway at a cost of £8500 for the Royal Agricultural Show at Warwick from July 7th to 11th next, is complete. Here the whole of the rail traffic, cattle, agricultural implements and other exhibits passing to and from the Show will be handled. The station has a platform of 700ft. in length, constructed to afford every facility for the careful and expeditious loading and unloading of the traffic. A fleet of between thirty and forty G.W.R. tractors will be employed for the conveyance of traffic to and from the Show ground.

THE way in which railway servants supported the companies in their efforts to obtain powers for road transport was very gratifying. That the railways may continue to rely upon the support of their men in this direction is shown by the remarks made by a speaker in support of a resolution from Leeds at the recent Railway Clerks' Association meeting. That speaker said that while the railways had to make and equip their own roads, provide stations and signalling and safety devices, which cost many millions of money, their competitors were allowed to go on the roads and do infinite damage to life and property. The railway companies were the largest ratepayers in the country, and the money they paid was largely used in subsidising their competitors.

THE electrification of the Manchester South Junction and Altrincham Railway draws attention to the early history of that line. As we were all reminded last year, the Liverpool and Manchester Railway was opened in September, 1830, with the terminus in the latter city, near Liverpool-road. On June 4th, 1840, the first section, at the Manchester end, of the Manchester and Birmingham was opened with a terminus in London-road; it joined the Grand Junction at Crewe on August 10th, 1842. The original member of the Manchester, Sheffield and Lincolnshire Railway—later the Great Central—was the Sheffield, Ashton-under-Lyme and Manchester, which connected with the Manchester and Birmingham at Ashburys on November 17th, 1841, and ran into London-road Station. When the London and North-Western was constituted in 1846 it was considered desirable to join the Liverpool and Manchester and the Manchester and Birmingham by a line from London-road to Ordsall-lane. The M.S. and L. wanted to go into the Cheshire area and it was agreed to build the "South Junction" Railway and a line from Knott Mill to Altrincham at the joint expense of the two companies, and these were brought into use on July 21st, 1849. Until quite recent years the M.S.J. and A. had its own officers, staff and carriages, with the Great Central providing the locomotive power. In those respects it was like its neighbour, the Cheshire Lines Committee.

THE circumstances that led to the collision of January 16th on the Clacton single line branch of the London and North-Eastern Railway were inquired into on behalf of the Ministry of Transport by Colonel Anderson, as noticed on page 142 of our issue of January 30th, wherein a diagram of the lines and signals concerned was given. It may be remembered that the newspaper train had made a trip from Colchester to Clacton, where the train was reversed and left, with a fresh engine and enginemen, for Thorpe-le-Soken. On arrival in the loop line the engine ran round its train and, that done, the guard said "Right away" and the train started with the intention of going to Walton-on-the-Naze. Owing to the approach of a down goods train the road could not be "made" for Walton and lay for Clacton. Despite that the signals were at "danger," the train started and, because the junction was not set for Walton, the train proceeded towards Clacton. Though it was dark, the enginemen ought to have noticed the mistake by the distinct contrast in the two branches, but they did not, and, the line being single, the train met a light engine head on. Both the erring enginemen were killed. The guard claims that he was busy sorting parcels at the time. Whilst Colonel Anderson, in his report just issued, puts most of the blame on the driver of the newspaper train, he considers that it is the duty of the guard to ensure the safety of his train before the sorting of parcels. He recommends that the rule on that point should be enlarged. Colonel Anderson also thinks that it was irregular to give the driver the single-line token to go to Walton directly he arrived from Clacton; had there been a pause until the train was ready to go it would not have been issued. An amendment of the rule concerned is recommended. Automatic train control or a safety point in the loop would have prevented the accident.

Notes and Memoranda.

A CHICKEN farm in the United States is said to have proved that the egg-laying capacity of the birds can be increased by 70 per cent. by subjecting them for two hours daily to ultra-violet rays.

IN connection with the new waterworks at Amoy, on the coast of China, it has been arranged to lay mains on the island of Kulangsu. Water will be taken to the island by a boat of 400 tons capacity and pumped up into a reservoir on the top of a high hill.

TWO factories are just now being erected in the United States neither of which has any windows. One is for the manufacture of gears and tools, and the other for papermaking. It is claimed artificial lighting gives more uniform conditions than windows, and that the worker's output is considerably increased, while the running cost is little greater.

A LARGE steam accumulator has just been made for a Greenock sugar refinery by Cochran and Co. (Annan), Ltd. It is 14ft. 9in. in diameter by 51ft. long, is designed for a working pressure of 160 lb. per square inch, and weighs 65 tons. It was impossible to deliver it by road or rail, so it was made water-tight and launched into the river Annan, whence it is being towed to Greenock. Afloat the accumulator draws about 5ft. of water.

AN article in *Machinery* describes how bushings can be expanded into their seatings by making them oversize and shrinking them by immersion in liquid air before they are put in place. They are held in the liquid air for about five minutes. A shrinkage allowance of 0·0027in. per inch of diameter has been found satisfactory for steel tubing and an allowance of 0·0037in. per inch of diameter for bronze bushings. Bushings made from what is known as "double-refined iron" have been assembled with an allowance of 0·0021in. per inch of diameter. In order to determine how tightly these bushings were held in their component parts, a steel bushing about 3in. in diameter was pressed out by hydraulic pressure. It was necessary to apply 30 tons of pressure to start the bushing, and this pressure had to be maintained at 20 tons until the bushing was fully removed. For a double refined iron bushing 2·7/16in. in diameter, the corresponding figures were 20 and 10 tons respectively.

THE world's first pound of one of the rarest metals, indium, has now been made electrolytically by the Grasselli Chemical Company in Cleveland, Ohio. We understand that it is valued at 7000 dollars, nearly ten times the cost of platinum. Indium is a white, lustrous metal, very soft and ductile, melts at 155 deg. Cent., boils at 1450 deg. Cent., and is slightly heavier than zinc. In fact, it resembles zinc in some respects, and aluminium and iron in others. It does not tarnish appreciably in air at ordinary temperatures, but oxidises rapidly above its melting point, burning with brilliant violet flame at higher temperatures. So far, commercially, it has remained a laboratory curiosity. However, this was once true of helium and many other elements. There is already a British patent covering its use in bearing metal. The fact that a new process makes indium available should stimulate interest in its practical applications. It may be found to have a definite field of usefulness.

A NOVEL, though small, use for coal gas is mentioned in the *Chemical Trade Journal* as follows:—The value of ethylene gas in accelerating the ripening of citrus fruit has been known in the United States for a number of years past, and has been successfully employed in the Californian orange industry. The presence of ethylene in ordinary coal gas and the world-wide availability of this latter material have recently directed attention to the possibility of the use of coal gas for the purpose instead of ethylene, and it is reported that good results have been obtained in the banana industry. Trials have already been carried out, and it is stated that by following the following method, not only is the maturation of the green fruit greatly accelerated, but the quality of the ripe fruit is improved. Coal gas in the proportion of 1 part to 2000 parts of air is introduced into the ripening chamber in the morning. The temperature in the chamber is maintained at 20 deg. Cent., and the relative humidity of the atmosphere at 85 to 90 per cent. The air is kept in continuous movement inside the chamber by means of a fan. When the bananas commence to change colour, the addition of the gas is stopped, and the relative humidity of the atmosphere reduced to at least 70 per cent., whilst finally the chamber is freely ventilated.

IN lecturing to the Royal Society of Arts on stainless metals, Sir Harold Carpenter gave the following explanation of the effect of chromium on iron. Iron, he said, may be rendered passive in many ways. When it is immersed in concentrated nitric acid it is unattacked, although dilute acid dissolves it readily, and when it is withdrawn from the concentrated acid it shows a temporarily increased resistance to corrosion. Similarly, it can be made passive by immersion in an oxidising agent, such as potassium chromate, or in a concentrated solution of an alkaline salt, such as sodium carbonate. In every instance the passivity is due to the formation of a thin film of oxide which protects the underlying metal. The films produced on iron by immersion in oxidising solutions have only a temporary effect on its resistance to corrosion after it is removed from the solution. Chromium, however, has a greater affinity for oxygen and the oxide films formed on it are continuous and adherent. Passivity is, therefore, more readily produced. When exposed to the action of dry air at ordinary temperatures, it becomes covered with a very protective oxide skin, while the films produced on heating are thin, continuous and protective. The action of nitric acid (specific gravity 1·2) on it is about 1000 times slower than on iron, and this metal becomes passive under the influence of reagents that do not produce passivity on iron. When high chromium steel is heated in air the oxide films produced are thinner and more protective than those formed on iron. Under conditions which produce deep-seated oxidation of ordinary steel, high chromium steel is protected by a tough enamel-like coating of oxide, and for this reason these steels, and other alloys such as the nickel-chromium and the nickel-chromium-iron alloys, are very suitable for use at high temperatures.

Miscellanea.

A GOOD deposit of Iceland spar has been discovered in Namaqualand, South Africa.

IT is proposed to manufacture alloy steel at the London Rolling Mills, London, Ontario.

THE Johannesburg City Council proposes to expend £500,000 on extensions to its power plant.

A SLIPWAY capable of dealing with vessels of up to 2300 tons is being built at Mombassa, East Africa.

IT is proposed to provide some deep-water berths at Durban, Natal, with a depth of 40ft. at L.W.O.S.T.

A FACTORY for the production of briquettes from Spitzbergen will probably be put up at Grorud in Norway.

THE Chinese Government has decided to expend about £10,000,000 during three years on the reconditioning of railways.

A STATION equipped with wireless and sound direction apparatus for navigational purposes is to be erected at Cape Mendozino, California.

A PLANT for the production of oil from limestone shale is to be put up near Ragusa, in Sicily. The output is to be 50,000 tons of crude oil a year.

A SHARK fishing industry has been started near the Bluff, Natal. At present it is getting from 3 to 4 tons of sharks a day, and a 15ft. shark is said to yield 45 gallons of oil.

A LARGE covered reservoir is to be constructed on the Plains of Abraham for the supply of potable water to Quebec. It will be 780ft. long by 310ft. wide and 20ft. deep.

A SEAM of coal 4ft. thick has been discovered at Allbright's Corner, Sunbury County, New Brunswick. It is said to be of twice the thickness of any seam now being worked in the district.

A BUILDING contractor in the Eastern States of America has adopted aluminium as a material for roofing, guttering, and such-like purposes. It is of No. 20 gauge and the sheets are welded together by the blow-pipe.

THE White Star motor passenger liner "Britannic," which arrived at Liverpool on Monday last, May 18th, from New York and Boston, completed the ocean crossing in 6 days 8 hours 53 minutes, thereby breaking her previous record by 3 hours 20 minutes.

A SETTLEMENT has been reached in the dispute at the British Mannesmann Tube Company's, Ltd., Landore Works, near Swansea. The manufacture of seamless steel tubing will be resumed almost immediately and as soon as the plant has been overhauled.

THE Chinese Ministry of Communications has decided to construct a radio station at Shasi on the Upper Yangtsze at the earliest possible date, and has instructed the Shanghai factory for the manufacture of radio apparatus to supply the necessary radio materials and parts.

ARRANGEMENTS are being made for working a sulphur deposit in the crater of an extinct volcano 3 miles from Rabaul, on the island of Papua. The supplies are said to be practically inexhaustible and only a quarter of a mile from deep water, so the sulphur may be easily shipped to Australia.

IT is said that the decision of the Norwegian Antarctic whalers to cease operations next season will mean a loss of £200,000 in bunkering business to Durban. It is, however, reported that Unilever, Ltd., intends to go South for 50,000 tons of whale oil despite the fact that the Norwegian companies have a surplus of 70,000 tons for sale.

ACCORDING to the German *Chemische Industrie*, a young Russian engineer named Alexejevski has developed a process for the production of carbon-free ferro-chromium from ores found in the Urals. It is proposed to make a semi-commercial scale test of the process, and if the results are satisfactory to undertake the manufacture on a large scale.

DELEGATES of the Automobile Association are travelling to Central Europe as the representatives of British motoring at the Assembly of the Alliance Internationale de Tourisme at Prague from May 23rd to 26th. Among the questions to be dealt with at Prague is the development of the scheme proposed by the Automobile Association for an International Highway joining London and Stamboul and, eventually, London and India. This project has already been accepted in principle, and satisfactory progress has been made towards a practical realisation of a tourists' highway through Europe.

THE number of blast-furnaces in operation in the United Kingdom at the end of April was seventy-eight, compared with eighty-one at the beginning of the month and 151 a year ago, according to the monthly returns of the National Federation of Iron and Steel Manufacturers. The production of pig iron amounted to 323,200 tons, compared with 357,100 tons in March and 619,600 tons in April, 1930. The March output of steel ingots and castings amounted to 397,400 tons, compared with 500,100 tons in March and 696,100 tons in April, 1930, part of the decline being due to the Easter holidays.

CONTRARY to rumour, the work in connection with the construction of the Mettur Dam is, says *Indian Engineering*, progressing satisfactorily, and the dam has risen to about 60ft. on the left flank. Dam construction on the river bed has been going on for the last few months, and our correspondent is authorised to state that the Mettur Dam will be completed in 1934, while water for irrigation to certain parts of the Tanjore District will be made available by the end of 1932. The question of water supply to the Salem Town, from the reservoir that will be formed on the completion of the Mettur Dam, has been reopened for a third time, and there are indications this time that the scheme may be taken early. Investigations as to how to overcome the engineering difficulties are going on. In case the Government of Madras decide to supply Salem with the Mettur water, a storage tank on a higher level than the Mettur reservoir is proposed to be constructed, and the water thus stored will be conveyed to Salem, 25 miles away, by means of pipes.

THE MARTINEZ-BENICIA BRIDGE—SUISUN BAY, CALIFORNIA

(*For description see page 562*)

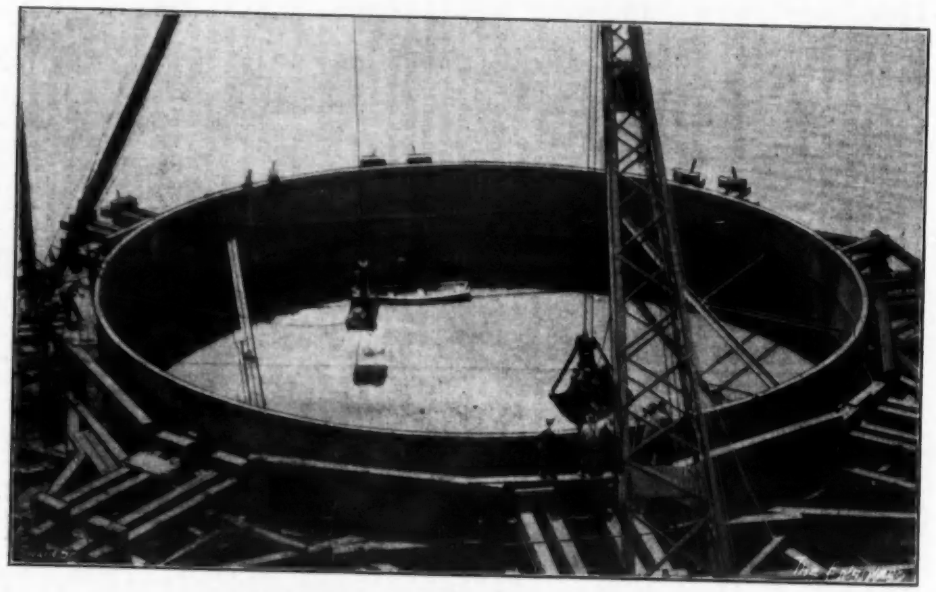


FIG. 1—ONE OF THE STEEL SHELLS IN POSITION

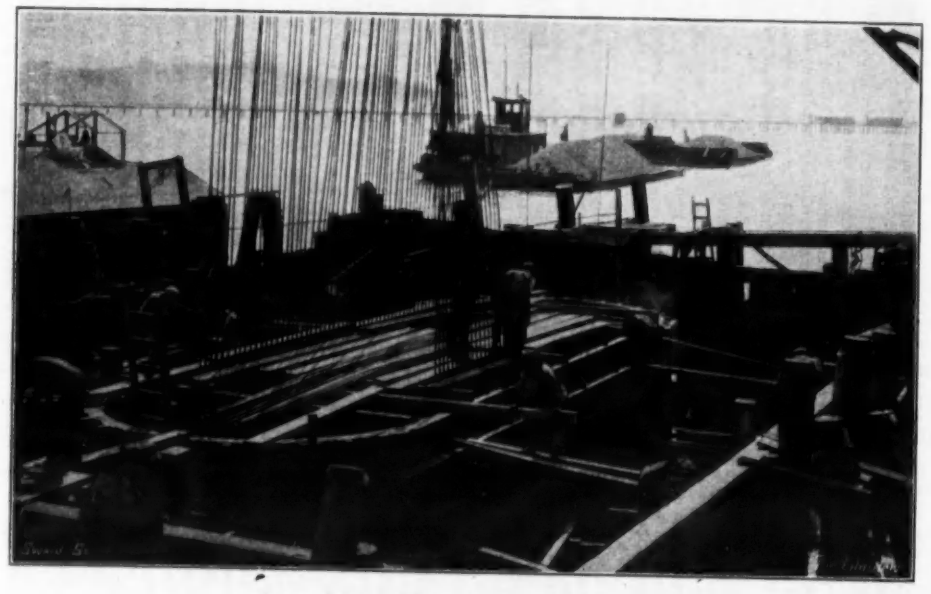


FIG. 2—TOP OF ONE OF THE PIER FORMS

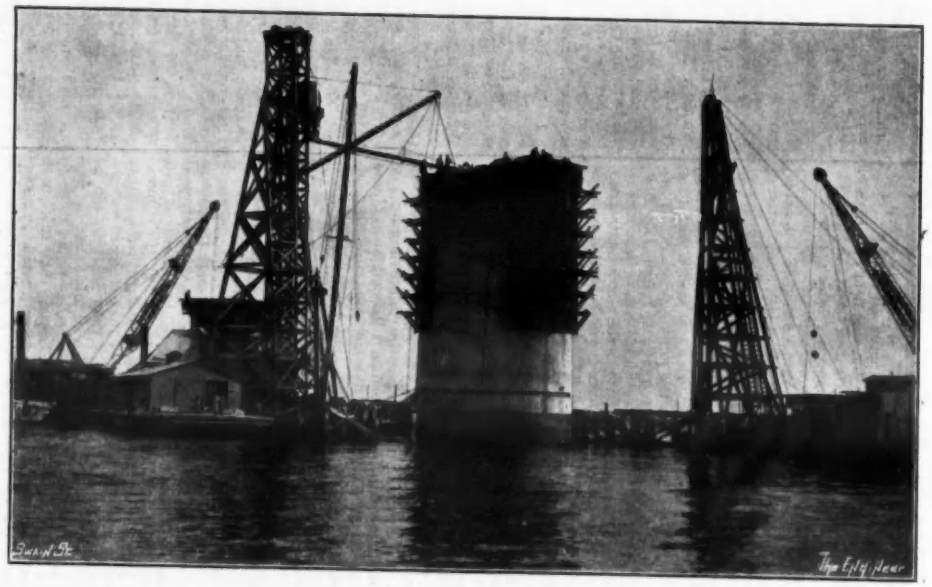


FIG. 3—SUMMIT OF ONE OF THE MAIN PIERS

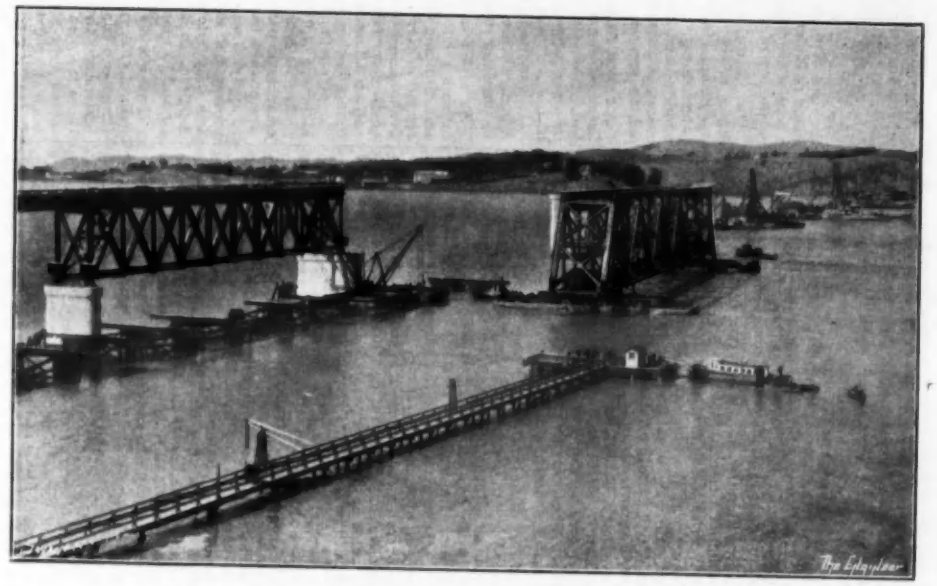


FIG. 4—FLOATING DECK SPAN INTO POSITION AS PLATFORM

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THE ENGINEER.

VOL. CLI No. 3932

MAY 22, 1931.

The Paris Fair.

THE fact that the British participation in the Paris Fair, which was opened last week, is much less than it was a year ago, while the German industry continues to extend its representation, is worth noting at a time when everyone is looking to the possibility of developing foreign trade. It appears that most British firms regard it as futile to spend money on a show in a country whose customs duties are against them. The same duties are paid on German goods entering France, and yet every year sees an increasing number of German exhibits at the Fair, to the extent that they dominate some machinery sections. It is obvious that the Germans are unable, any more than the British, to spend money uselessly, and there is plenty of evidence to show that the expenditure is accompanied by some business. It is affirmed by the Fédération de la Mécanique that during the past few years Germany has supplied 66 per cent. of the total mechanical imports into France, while the British contribution is only 8 per cent. The reasons for this state of things may be found in the methods adopted as revealed at the Paris Fair. The British manufacturer very naturally seeks to get his profit, while the German aims at getting the business. British goods are not shown to a sufficiently large extent because, with the burden of tariffs, the prices are regarded as too high, and it is not thought worth while to go to the expense of exhibiting when there seems to be little prospect of securing any immediate benefit. Consequently, British machinery is almost a thing of the past in France, where, nevertheless, it is still remembered and associated with the best. The British reputation is a valuable asset when manufacturers see their way to push their goods in continental markets. The German manufacturer prefers not to wait, but to get into the market, even if he has to make a sacrifice, and it is probable that sacrifices are accepted as the price of future benefits. It is undeniable that the Germans are going to an enormous expense in showing their goods to foreign buyers.

An inspection of the exhibits at the Paris Fair revealed that in a time of normal trade activity, there is business to be done in France in practically all kinds of machinery. In machine tools, for example, the French have made considerable headway, and their position has been strengthened by the resources of Alsace, with its varied engineering industries which have exercised a distinct German influence upon French machine tool design. Nevertheless, French manufacturers find themselves limited to the production of machines for which there is a sufficiently large home demand. They cannot undertake the manufacture of machine tools that can only be turned out economically when the possibilities of sales at home are supplemented by an export trade. Nor have they succeeded yet in doing much in the way of high-class precision machine tools. There is, for example, no French manufacturer of gear cutting or grinding machines, though it is reported that Cuttat, which was the first firm to undertake successfully in France the production of automatic lathes, is preparing to manufacture grinding machines. Therefore, amongst the extensive exhibits of machine tools there was a strong foreign participation, mainly of types or classes of machines that the French do not produce themselves. With such firms as S.O.M.U.A., Huré, Cuttat, Ernault, the Société Alsacienne, Sculfort-Fockedey, Vautier and Cie., and the many other machine tool firms in and around Paris and in the North of France, the production is large and covers most normal requirements, from the heaviest milling machines and radials to small shop lathes, but French agents of American automatic lathes showed machines that the French cannot produce, and the Germans exhibited grinding and gear-cutting and other special machines. A point to be emphasised is that, except perhaps in the Albert and Maubeuge districts, where the machine tool industry is partly centred, the French have no advantage over some foreign competitors in production costs, and tariffs do not keep out foreign machines when they are needed. Alfred Herbert, Ltd., is the only British firm to make an individual effort, through the Société Anonyme Alfred Herbert, to keep a hold on the French market, and its stand was one of the most interesting in the Fair. The only other English machines were some Archdale drilling machines and Ward lathes on a French stand. The same dependence of French users on some classes of foreign machines was observable in printing machinery, and in this section British firms had disappeared altogether. Woodworking machinery offers less scope for British makers, because requirements are so fully met by French manufacturers, but, nevertheless, there was a fairly strong foreign representation of foreign machines. There is always a market for machines that do work better and more cheaply than others. Oil engines were represented by the National Gas Engine Company, Ltd., and L. Gardner and Sons, Ltd., and the Société Anonyme Ruston-Hornsby et Lister, which was formed some months ago to handle the Ruston-Hornsby and Lister engines, made a worthy exhibit of these prime movers. Oil-engined road rollers were shown by Aveling and Porter, Ltd., and also by Barford and Perkins, Ltd., the latter exhibiting five different sizes. In the section devoted to contractors' plant the Germans were extensively represented, and it seemed that the impulse given to their participation was due to the multiple applications of the solid-injection engine, which was shown as in use for all purposes—road rollers, contractors' locomotives, concrete mixing machines, air compressors, and all other public works equipment. As concerns the value of the annual gathering in Paris as a means of reaching customers over a great part of the Continent, it is possible that something will be said officially in due course, for Mr. Gillett, of the Board of Trade, has this week paid an official visit to the Paris Fair.

We have entered upon a period when everyone looks for cheapness, and it is not unreasonable to assume that foreign manufacturers must get a profit somehow out of prices that would appear, at present, to leave them no profit at all, particularly in view of the heavy expense incurred in obtaining trade. The labour put into some of the goods at the Paris Fair has been reduced to a minimum, and if such goods are cheapened still further they will not be cheap at all! The French are watching the course of events. They know that cheap goods will not satisfy everybody, and they believe that when business settles down again there will be a demand both for cheap goods and for goods of better quality. The British manufacturer will then have his chance if the margin of

price between the two is not so great as to deter buyers. His opportunity exists even now, for, though demand has fallen so low as to be almost non-existent, except in some cases, such as contractors' plant and machinery for colonial development, the British manufacturer has, nevertheless, every interest in following the example of his rivals and preparing for a trade which can only be obtained by keeping before buyers the special merits of his productions. In order to do that the manufacturer must change entirely the methods he has adopted so far in an attempt to reach foreign customers. He must know how to approach them and how to deal with them and how to adapt himself to the commercial diplomacy which is becoming more complicated abroad as competition increases. In most cases little can be done except through a sales engineer who has been trained in the country.

The Government's Airship Policy.

FOLLOWING upon the disaster to the "R 101" and the very indefinite finding of the Simon Committee concerning its cause, a decision to continue building airships would have required no small amount of courage on the part of the Government. A decision to abandon all that has been done and to withdraw completely from further participation in the construction of airships would have required still greater courage. It came, therefore, as no surprise when it was announced by the Prime Minister last week that the Government would neither continue with the programme drawn up in 1924 nor scrap everything, but would seek to pursue a middle course. The intention is that the country shall maintain a scientific experimental interest in airship development and shall place itself in a position to resume without delay the active construction of airships if and when developments justifying or necessitating such resumption occur. In detail the Government's policy is to undertake no new construction, to preserve the Cardington works as a nucleus, to maintain the bases at Ismailia and Karachi, and to keep "R 100" in flying condition for experimental purposes. This policy, it is officially estimated, will involve an expenditure of £120,000 in the first full year and of £140,000 in the third year. It is not very difficult to detect the broad reasons which have led the Government to its decision. They may be summed up in the two words embarrassment and sentiment. The Government is embarrassed by the existence in this country and overseas of the sheds, mooring towers, hydrogen plant and other equipment provided under the programme of 1924. It is sentimental concerning the "R 100," the trained airship crews which we still possess, and the skilled airship constructors remaining at Cardington. In spite of its expressed intention of maintaining a scientific interest in airship development, there is no direct evidence that its decision has been primarily influenced by scientific and technical considerations.

On the material side the Government proposes to expend money on the maintenance of the airship bases in this country, Egypt and India. They are to be kept in repair and prevented from falling into disuse. Yet in two important respects the equipment at these bases is open to criticism. First, the British form of mooring tower is expensive to construct, and as several experiences last year showed, is by no means the highly convenient and efficient device which it was at one time supposed to be. The American stub tower, at which the airship rides close to the ground, is claimed by many to offer important advantages. Secondly, a large portion of the equipment at the bases is devoted to the manufacture and storage of hydrogen. It is practically certain that that dangerous gas will never again be employed in airships, except possibly for experimental purposes or in emergencies. On the personal side, too, it is easy to form a wrong picture of the situation. The skilled airship builders at Cardington, of whom much has been said in Parliament, are largely mythical. The workers at that establishment were trained *ab initio* specially for the construction of "R 101." In large part they were women and were engaged on such operations as sewing and doping the fabric covering and in piecing together the goldbeater's skins which constituted the gas bags. The engines were not made at Cardington. They were designed and produced by the skilled workers of a private firm in Glasgow. The bulk of the elaborate framework of the "R 101" was designed and fabricated by the skilled workers of a private firm in Norwich. Finally, the whole of the "R 100" was produced, not at Cardington, but entirely by private enterprise. Of the trained crews we need only say that, with the exception of one or two of the higher officers, they were trained in airship work while their vessels were being built and tested. If they were disbanded we would be in a position no worse in this respect when, if ever, this country resumed airship building than we were in at the start of operations on the "R 100" and "R 101." Of the higher design and experimental staff respect for the memory of those who perished in the "R 101" should not be allowed to obscure the fact that their main problems were solved for them, or were carried towards solution, largely as a result of the continuous attention which has been paid to the development of the aeroplane. It was the pioneering work undertaken by Boulton and Paul on the construction of metal-framed aeroplanes which enabled that firm to design and make successfully and without hesitation the structural parts of the "R 101." The Beardmore heavy oil engines were produced expressly for that airship, but their development will not be stopped if we build no more airships. Oil engines of a similar type are required for aeroplanes, and their production is being studied by several firms in this country and by many firms abroad. On the material and personal side the situation, it is submitted, may be left to look after itself without the adoption of any definite airship policy on the part of the Government. The developments required to make airships successful will come, if ever they come, from developments in the building of aeroplanes supplemented by discoveries and progress in several other industries and arts having no direct connection with the building of airships.

If anything were required still further to demonstrate the wrong basis on which the Government has taken its decision it would be provided by the attitude which it has adopted towards the "R 100." The fate of that vessel has been the central point about which the Government's policy has been made to turn. The idea of destroying or disposing of it was dismissed as being out of the question, and a scheme was sought under which in some way it might be preserved for a useful purpose. The suggestion conveyed by the Prime Minister's words and supported by Sir John Simon in the ensuing debate is that the "R 100" is to be regarded as a promising experiment which has been blighted by the untimely misfortune that befel its companion. We should be glad to learn the justification of that suggestion. It is not, we submit, justified by anything which the vessel accomplished before it was laid up. To its credit it has a round trip to Canada. Ten months after the event the public can now study the incidents of that voyage from the unedited diary of one who took part in it, Mr. N. S. Norway, chief engineer to the builders of the vessel, the Airship Guarantee Company. That diary, published in the May issue of the Royal Aeronautical Society's *Journal*, was written by one who was not in the least likely to exaggerate the difficulties of the voyage. Yet throughout it there is a tale of defects and mishaps surmounted only by the skill and devotion of the crew, of risks daringly faced, and of disaster barely escaped on two occasions. The preservation of such a vessel should not in any way have been allowed to influence the Government's policy. Scientific and technical considerations are the only factors which should have been taken into consideration. There is no evidence in Mr. Macdonald's statement that they have been considered at all. The Government is unwilling to follow the lead of France and Italy, both of which have now abandoned their former considerable interest in airships. It is unwilling to jettison the proceeds, such as they are, of the airship policy which it itself initiated in 1924. It is unwilling, and it cannot be denied that many other people are also unwilling, that the lessons of the "R 101" disaster should be thrown away. We would share that view ourselves but for one fact. We are still waiting to hear precisely what that disaster has taught us.

The Royal Society's Conversazione.

ON Wednesday evening of this week the Royal Society held its customary conversazione at Burlington House. A large gathering of Fellows and guests assembled for the occasion. Following the reception by the President, Sir F. G. Hopkins, those present proceeded to inspect the numerous exhibits of scientific interest which had been arranged in the Society's rooms. For once, the exhibits were mainly of a physical description, the medical, biological, anthropological, and other sections of the Society's interests being much less prominent than is usually the case. We give below brief notes on some of the principal exhibits likely to appeal to engineers.

The National Physical Laboratory exhibited some photographs showing the application of the methods of X-ray crystal analysis to industrial problems. The photographs demonstrated the various types of information yielded by X-ray diffraction work. In connection with the study of metals, the illustrations showed the marked changes in the diffraction patterns of alloy steels resulting from heat treatment and the interpretation of these changes, the differences in the structure of transformer steels of low magnetic loss and the selective crystal orientation produced by cold working. Some studies of electro-deposited metals showed the large variations in the nature of the deposit under different electrolytic conditions. The use of the method for chemical analysis was illustrated by work on the constitution of surface scales on steels.

Dr. J. S. Owens showed an automatic apparatus for measuring smoke impurity in the air. This apparatus automatically filters through white paper a measured volume of air, leaving on the surface of the paper a black discoloration due to smoke, the intensity of which measures the amount of impurity. The equipment is operated by a weight, and can be set to filter volumes of 1, 2, 4, or 8 litres, depending on the concentration of impurity in the air. It requires winding and changing of the filter paper once in twenty-four hours, but is otherwise automatic. The aspiration is by means of bellows operated by a weight through gearing, and this bellows acts as an escapement, controlling the rate of operation. The records taken are ¼in. diameter and are spaced evenly around a paper disc.

Among several exhibits shown by the Research Laboratories of the General Electric Company, Ltd., Wembley, was one demonstrating applications of the X-ray powder method of crystal analysis. A collection of X-ray photographs was shown illustrating various applications of the Hull-Debye-Scherrer method of analysis. The subjects dealt with comprised (*a*) the effect of heat on a clay; (*b*) various forms of alumina; (*c*) the nature of particles in two opal glasses; (*d*) a solid solution effect; (*e*) the development of preferred orientation in worked metals; (*f*) the crystalline nature of certain single-substance glasses.

Mr. W. Ewart Williams demonstrated the generation of short wireless waves (λ=6 cm. to 30 cm.) by means of a mercury vapour tube, the main oscillator being tuned to 3 m. to 6 m. By varying the coupling between the main oscillator and a 150 cm. long mercury tube, the latter can be made to glow and show a system of standing waves. In this condition the tube acts as a short wave radiator and acting like a diffraction grating gives sharply directional effects. Once the standing waves have been obtained at room temperature (mercury pressure 10^{-3} mm.), a side tube can be cooled to liquid air temperature (pressure 10^{-6} cm.). The only effect on the discharge is to make the nodes extremely sharp. If the discharge is now broken, the pressure must be considerably increased before it can be again established.

An exhibit by the Director of the Chemical Research Laboratory, Teddington, dealt with the corrosion and protection of metals. A series of photomicrographs of zinc and mild steel showed the changes that take place in the distribution of corrosion and of corrosion products when immersed in potassium chloride solution beneath an atmosphere of oxygen. Corrosion-time curves of the same metals in similar conditions with the controlling factors marked on each branch were also shown, together with the apparatus used for obtaining them. Specimens of copper with an artificially formed green patina were shown side by side with samples taken from old copper roofs. The principal constituent of the patina was stated to be basic sulphate of copper. Samples of technically useful light magnesium alloys were exhibited coated with protective and decorative films.

A source of considerable attraction was a small vertical wind tunnel with model aeroplanes spinning in free flight which was shown by the Directorate of Scientific Research, Air Ministry. The tunnel consisted of a short vertical tube with a flared intake and honeycomb and a fan at the outlet driven by a 1 H.P. electric motor. Small model aeroplanes were mounted above the centre of the honeycomb in such a way that they were free to rotate in a spinning attitude. When the wind was produced the model first rotated and then rose off its bearing and began to spin in free flight. The walls of the tunnel were of glass, and the spinning could be observed from three sides of the table carrying the tunnel. The tunnel was designed by Mr. R. McKinnon Wood, the Head of the Aerodynamics Department at the Royal Aircraft Establishment, South Farnborough.

Professor E. G. Coker showed some coloured transparencies illustrating the stress distributions in wheels. The transparencies showed the stress distributions in spoked wheels when an axle is forced into a wheel centre, and also when a tire is shrunk on. The further effects of loading a wheel by contact pressure with a rail were also demonstrated, diagrams of the measured values of the stresses being placed below the photographs.

Sir Robert Hadfield had on view some alloys of steel with special properties, and some testing apparatus and other exhibits of metallurgical interest.

The Katz CO recorder outfit, shown by the

Cambridge Instrument Company, Ltd., has been designed to give a continuous record of small concentrations of carbon monoxide in the air. Its action depends essentially upon the evolution of heat when carbon monoxide and oxygen combine. A stream of the air containing carbon monoxide passes through a mass of catalyst, hopcalite, which promotes the combustion of the carbon monoxide. The heat generated warms the gases and the catalyst mass and the rise of temperature, which is proportional to the concentration of carbon monoxide in the air, is measured by suitable thermo-couples. The recorder is calibrated to give a full-scale reading with one part by volume of carbon monoxide in 1000 of air. The sensitivity is such that it will readily respond to four parts in 10,000.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

MAIN LINE ELECTRIFICATION.

SIR,—Lord Monkswell is not likely to find many engineers who will follow him in the implications of his letter on the above subject in your issue of May 8th. He suggests that British steam locomotive engineers have neglected a 30 per cent. margin of improvement in power per ton weight, and he states categorically that "there is every sort of defect to be eliminated" from the electric express locomotive.

To some extent both criticisms carry their own refutation by reason of their extravagance. It is surely incredible that the country which has led the world in locomotive design should have failed so egregiously in building a locomotive to give the best economic performance possible under British track and loading gauge limitations. It is equally incredible that the electric express locomotive, which is giving satisfactory service in so many parts of the world, should be nothing but a mass of defects.

Coming to particulars, Lord Monkswell declares that no satisfactory method has yet been discovered of transmitting power from the electric motor to the driving wheels. "All arrangements so far tried have a tendency to pound the road." He appears to be thinking in terms of the early designs, where the motor was mounted direct on the axle. Even so, electric locomotives of this type, running at 60 miles per hour, have been in satisfactory operation on the Paris to Vierzon section of the Paris–Orleans Railway for three years.

In the later designs of electric express locomotive, the weight of the motor is carried on the locomotive frame and the motor connects with the axle through a flexible link drive which gives freedom of movement. By this arrangement the unsprung weight is reduced to a minimum.

The point raised by Lord Monkswell about the difference between leading and trailing bogies is of secondary importance. It is true that where a locomotive runs in only one direction it is worth differentiating between the two bogies. But the electric locomotive is essentially a double-ended engine, and this advantage far outweighs the small benefit derivable from any differentiation in bogie design. The determining fact is that on railways like the Great Indian Peninsular electric locomotives with identical leading and trailing bogies are working satisfactorily up to 75 miles per hour.

Lord Monkswell's references to the "serious difficulties" encountered by the Paris–Orleans Railway in "designing a satisfactory electric express engine" are misleading. That company adopted electrification eight years ago, and thought it right to experiment with various designs. As a result of these trials it has standardised for a great part of its work a design of electric locomotive without bogies.

Altogether, Lord Monkswell's letter appears to be inspired more by a remembrance of things past than by conditions as they exist to-day.

May 18th. A. H. JACKSON.

ELECTRIC GOODS LOCOMOTIVES.

FOR handling its good traffic in the New York electrified district, the New York Central has added to its equipment forty electric locomotives of 133 tons weight. The long coach-like body, with a driver's compartment at each end and apparatus compartment between them, is mounted on two six-wheel bogies having cast steel frames and 39in. wheels. A draw-bar between the bogies has a ball-and-socket bearing in each bogie frame, thus transmitting pull and buffing stresses and giving ample flexibility. Each axle is driven from a motor through gearing with a ratio of 69 to 20. The six motors have a combined rating of 2500 H.P.; they give a continuous tractive force of 31,620 lb. at 24 miles an hour, or 41,800 lb. for one hour at 22 miles, while there is a 66,500 lb. maximum tractive force for starting. Two two-stage air compressors, with a combined capacity of 240 cubic feet per minute, serve the air brake and air signal equipment, giving 140 lb. brake pipe pressure. The control apparatus is of the electro-pneumatic type, and arranged for multiple-unit operation when two locomotives are coupled up as one machine. Six running combinations can be effected, the main running speeds being with two motors in series on 600 volts, and six motors in multiple on 600 volts. A storage battery is provided for the control and lighting equipment. Two current collectors take the operating current from overhead conductors, and sliding shoe collectors take current where the third rail conductor is used. One engine can haul a train of 2250 tons on straight and level track at 32 miles an hour, and two or three engines can be operated as a multiple-unit locomotive for heavier trains. Their maximum speed, with light trains, is 60 miles an hour.

Trade with the Far East.

No. II.*—CHINA.

IN our last issue we gave excerpts from the Report just issued by the Economic Mission to the Far East which reached home little more than six weeks ago. We dealt then with the section devoted to Japan. In what follows we extract from the second part of the Report, which deals with China, paragraphs that apply particularly to the engineering industry, which, we may here remark, had but a single representative on the Mission, namely, Lieut.-Col. Reginald Morcom.

The China market, as it exists to-day, is essentially a low price market, and two questions arise :—

(1) How Great Britain can secure a greater share of this low-price market ;

(2) How the China market can be increased in volume and raised in quality.

PRICE AND QUALITY.

As regards question (1), it is obvious that British goods must, generally speaking, be far more competitive in price than they now are. Our competitors are securing the trade by supplying merchandise of sufficiently good quality at prices which purchasers of small means can pay. The increase of trade secured by Germany, Japan and the United States in the China market in recent years—a period in which Great Britain's share has declined—is mainly attributable to price. Price is the determining factor, and no amount of expert salesmanship or publicity will ensure a market for goods which are beyond the purchasing power of the consumer, or which are higher in price than other equally suitable goods.

It is significant that, compared with pre-war years, Great Britain's export trade has declined, in the main, to countries having a low standard of life. For example, of our total exports the proportion going to China was about 25 per cent. lower in 1929 than in 1913, to India 16 per cent. lower, and to Brazil 18 per cent. lower, whilst of our total exports the proportion going to countries enjoying prosperity and a high standard of life, such as Canada, New Zealand, and the United States, shows a marked increase.

It is therefore for consideration whether Great Britain's industrial structure and methods of production are such as to enable her to supply goods of wanted qualities at competitive prices to consumers of low purchasing power who form so large a proportion of the world's population. The evidence undoubtedly leads one to the conclusion that we are endeavouring to sell goods of a quality and cost higher than many of the markets of the world are willing or able to take. Great Britain has not been beaten anywhere in the world in high quality or high standard goods. She has been beaten almost entirely in the supply of bulk goods for the great mass of ordinary people. It seems to us that if we are to employ fully our people and factories at home we must reorganise the policy, methods and conditions under which we work and live, so as to enable us to supply bulk lines of staple goods, as well as quality and luxury goods. To-day the world does not place so high a value on quality, durability, and dependability in manufactured goods as it did in former years. To these altered conditions in most of the world's markets we must adjust our industrial life at home, if we are to hold or increase our export trade.

THE CHINESE MARKET.

As regards question (2), the development of the China market must depend very largely on China being equipped with railroads and other facilities for transportation, with light and power plants, and with agricultural and industrial machinery. It is surprising to find that China's principal import is food—in the form of cereals and sugar, both natural products of China—although she is one of the largest agricultural countries of the world. In 1929 imports into China of cereals and sugar were valued at £33 million, equal to 20 per cent. of the value of all imports. Lack of transportation, banditry, and irregular local taxation within China account for this state of affairs. If financial and industrial interests in Great Britain could arrange to assist in equipping China with means to an adequate economic life, the results would be an immediate stimulus to British industry and the prospect of an increasing market for British goods in future.

Railway Construction.—That the railways of China, totalling 8750 miles, are quite inadequate for proper development is recognised by all. The Chinese Ministry of Transport recognises it, demanding an immediate construction of 6000 miles of new line, to be completed in six years. Even this programme is considered conservative by those who support Dr. Sun Yat Sen's programme of 2000 miles a year for fifty years. Of the mileage actually available the physical condition is very poor and much expenditure will be required for rehabilitation. Further construction is essential, but at present is quite held up for financial reasons.

The situation with regard to railway construction in Manchuria is distinctly different from the situation in the rest of China. The money required for the construction of Chinese railways in Manchuria is collected by the Chinese locally. The Governor, the Bank of the Province, all important personages interested in the development of the district to be served by a new railway, agree to participate in the formation of a company. During the construction period and before the receipt of money from the shareholders the Provincial Bank is prepared to advance money to the Administration of the railway. The finance of these projects generally involves credit terms on the part of contractors, but so far experience has been satisfactory.

It will be clear from the urgent need for rehabilitation and new construction that a large trade, not only in plant, but in the other numerous requirements of railway construction is imminent. But close pricing and financial accommodation are indicated.

OPENING FOR LOCOMOTIVE BUILDERS.

Rolling Stock.—In view of the fact that the Chinese Government has appointed a central purchasing commission at Shanghai, it would appear that the time is ripe for British locomotive manufacturers to send out a representative to examine the situation and make acquaintance with the members of the commission, and in particular to study the financial methods by which terms may be made reasonably acceptable.

The opinion is held among engineers in China that militating against our competition in railway rolling stock are the following handicaps :—

(*a*) Our locomotive manufacturing firms are smaller than those of our competitors, due largely to the fact that our own big railways manufacture their own locomotives and therefore do not provide a home market.

(*b*) Owing to distance our delivery dates are frequently less attractive than those of our competitors. This also may be partly caused by the same consideration as under (*a*).

(*c*) Far and away more students study railway methods in the United States and elsewhere and are naturally buyers of the products of their teachers. To accentuate this tendency, in offices and waiting rooms of the Railway Administrations are large numbers of American catalogues, journals and photographs of United States works and achievements, but of our British literature and illustrations there is practically none. We need to undertake propaganda work in both these directions. Surely it should be possible to arrange for the Chinese railway students from their Nanyang University to study our great British railway systems and the works of our locomotives and rolling stock manufacturers. Surely it should be possible to arrange for the necessary literary propaganda.

(*d*) Our competitors' prices are frequently lower than ours, but those who know our products recognise that they are very much better and more durable. This is shown up clearly in repair departments, where the frequency of repairs on competing locomotives is much greater than in the case of British ones. Of course, the specifications to which the locomotives are built are different for each country of origin, China not having developed any standard specifications of her own. The competing vehicles which we saw made it clear that the British specification was altogether on a higher plane. The very fine locomotives recently delivered from Great Britain to the Canton-Kowloon and Shanghai-Nanking railways should have a great educational effect.

(*e*) The credit terms offered by our competitors are better than those which the British suppliers are prepared to give.

(*f*) Our competitors keep resident experts in China ; we do not.

MOTOR CARS AND MOTOR BOATS.

Motor Cars.—American motor car manufacturers have been most energetic in their pioneer work in this market. They appear to have ample financial facilities to do business on deferred payment terms and have spent and are spending large sums on demonstration and propaganda in China. The Americans are strongly entrenched in the market with resident factory representatives, good agents and ample supplies of spare parts. On the other hand, British motor cars are very little known or used and very little serious attempt appears to have been made by British manufacturers to enter the market on any considerable scale. In view of the greatly increased mileage of highways recently constructed in China and the still greater new mileage planned, it is imperative that British manufacturers lose no time in closely investigating the requirements of a market which is likely to prove very large. Cars and trucks of moderate price, with engine power of ample capacity for flexible driving and simple to handle will form the bulk of the demand. It is essential that British vehicles should be demonstrated in China, followed by intelligent advertising and propaganda. For such work a group of British makers of passenger cars and trucks should establish an intelligence and demonstration centre in China.

It is estimated that apart from treaty ports not more than 5 per cent. of the motor vehicles in use in the interior of China are of British manufacture.

Water Transportation.—The increased use of mechanical power to replace or supplement sail on the

* No. I. appeared May 15th.

Chinese waterways leads to a considerable demand for engines. Small steam engines are now easily made locally and local firms are also prepared to make some of the simpler types of oil engine in small sizes. But there is a good market in imported Diesel engines. Unfortunately, our prices are on the high side and our ability to service our engines is less than that of some of our competitors. Also our manufacturers are more insistent on the cash basis than our competitors. Discrimination should be made between good and bad risks, and there are many of the former.

How great is the competition in crude oil engines is shown by the fact that forty-four different makes are represented in China. Three important continental firms, M.A.N., Sulzer and Deutz, have strong staffs of experts and engineers. This is a market where a real expert and a good supply of exhibition and consignment sets is necessary. Deutz, for instance, carry about 2000 H.P., from 8 to 200 H.P., in stock.

British engines can be sold on quality by a live agent, but this is a business which is no use to mere "order takers," a description which after all fits many of the merchants. Order getters are needed and these must be expert engine salesmen. The sizes in demand are from about 8 H.P. up to 600 H.P.

Electrical Plant, Etc.

Electricity Supply.—The British share in electrical development in China has been very considerable so far as power plant is concerned. British industry has equipped the greater part of the big Shanghai power-house and has supplied large plant for such installations as the Mukden Arsenal, Tientsin, Kowloon, Hankow, Hangchow, and for a large number of small isolated installations depending on Diesel engines or small steam engines.

Since 1923 the British contribution has averaged about 40,000 kW a year, compared with an estimated annual increase in the plant capacity of between 50,000 and 60,000 kW.

In general, finance schemes will be required for the extension of China's power supply. These schemes may take the form of municipal bond payments or of arrangements to pay out of revenue, and only in a limited number of cases will companies be floated to do their own finance in the usual way. Possibly co-operation with foreigners will be possible in some of the large schemes through some form of construction and operating corporation. The recent order for two 5000-kW turbo-generators for Nanking has been accepted on terms arranged by the National Construction Commission; 20 per cent. will be paid in cash and 80 per cent. in 8 per cent. seven-year bonds issued by the Commission and backed by the States Council of China. The terms were accepted by the Siemens Schuckert Company, and it would be interesting to know what support they got from their Government.

Water Supply and Sanitation.—The pioneers of these important utilities have been British, and with numerous examples in China of excellent works carried out by them they should stand well for future contracts, if they are enabled to arrange the necessary finance. This may not be easy, as the terms of payment are not gilt edged. The foreign concessions have all got works of their own which are constantly in the market for plant and materials.

Communications.—American enterprise has been particularly active in communications which have a bearing on industry, above all telegraphic and telephonic communications.

In actual construction work good orders have been secured by British contractors in the past, but they are now losing them owing to strong competition. In many parts of China and in particular Manchuria the local Chambers of Commerce are strongly in favour of telephone installations. It is probable that similar terms of credit will be asked for to those granted at Canton and probably the risk will not be serious.

Iron and Steel.—Even with all conceivable iron-works development, it seems certain that China can never base a large engineering industry on home-produced iron. The iron industry of S. Manchuria has not overcome the low quality of the ore as well as was hoped, though the output has reached 300,000 tons. Any future developments are likely to be under Japanese control for many years to come, and the iron produced will almost certainly go to Japan.

The restoration of the many mines which are at present almost at a standstill and the modernisation of those which are being run on antiquated lines are both subjects which are being closely investigated by the Chinese Ministry of Industry. If the Chinese Government invite foreign co-operation and can arrange suitable and equitable finance, a considerable machinery business will develop both in connection with coal and iron mining and in the subsequent production of iron and steel in China. If we are to have our share in this development we must clearly be prepared to take our place in this co-operation.

Summary.

This survey of the metal and machinery market in China has been set down to show how wide is the field for industrial development, and how varied the openings for importers who are prepared to exploit them. The rate of development with an end of civil war and a rehabilitation of the currency may well be phenomenal. The first need will be improvement of roads and railways, which will bring about a readier movement of the products of agriculture and so greatly increase the surplus earnings of the people. This will enable the increased use of agricultural machinery and irrigation plant, so multiplying the benefit. Following this will come the tendency to work up the agricultural and mineral wealth of the country, to which end a rapid increase of available electric power will contribute. In all this development machinery will take a large part, and there can be little doubt of great trade openings for suitable plant. But such a system of development, starting with insufficient capital, presents the immediate difficulty of having to install the means of wealth production first and wait for the reward from the operation thereof. The demand for long credits is the result of this necessity. A further difficulty is that though China is anxious for native control of her own industries, it is not easy to get Chinese capital from those who have it, as they can often lend it at 3 per cent. per month to their less fortunate compatriots. The cure for this must lie with the Government. They themselves are showing every willingness to play their part in devising schemes for enabling foreign capital to be used without undue risk until their own capitalists are better educated or usury is better controlled.

By putting "tags" on loans or credits, immediate returns may be effected; but in the larger future buying will become free and the buyers will be largely influenced by their own experts, and these will be largely influenced by the school in which they have been trained. That our competitors have done more in educating Chinese in the past than we have is notorious. It seems essential that we take a more important part. Chinese students from our own university of Hong Kong and from Chinese universities should be given opportunities of technical training on British railways, in British public works and in British factories. Some scholarship, or other system, should be devised to defray their expenses. The returned students would not only be propagandists for British products if they were employed in Chinese engineering, but could supply technical salesmen for our merchants and agents and add greatly to the efficiency of their sales organisations.

The China market for machinery is a very competitive one, as well as a very speculative one. At present, and for some time to come, it will suffer from lack of capital and lack of knowledge. Both these will militate against spending money on high-quality materials and machinery, and to sell such goods against low-priced competition will be difficult, but the difficulty must be faced, for it is in the better quality lines that we excel. To give up this position and confine our competition to price is to sacrifice one of our greatest advantages.

A careful study of local requirements for, say, a cheap sturdy lathe, a small simple oil engine, or a handy oil press, may enable us to specialise on a cheap mass-produced article and so help our total sales. But we must still keep on educating the Chinese in the meaning of equal specifications, for, given these, our prices are, contrary to often expressed opinion, quite competitive. It is not British practice to gamble on overheated motors or on cast steel doing as well as forged and we should stick to our practice and not try to copy inferior competing standards. The oft iterated catchword that the British maker will not change his standards to suit the market is meaningless; our competitors do not do so either. They force their standards on the market; then our merchants want us to copy them. There is a bit too much catchword argument among traders in the Far East when discussing their own and the manufacturers' difficulties, such as "A merchant must live," "British manufacturers are behind in invention," "British catalogues are bad," and a dozen others were thrown at us with wearying frequency. Though catchwords may contain a small foundation of fact, they are usually a convenient method of begging the question. Taking the one about invention, for instance, actually far more originality in invention has been shown by Great Britain than by any other nation, and many successful exploitations by our competitors are the result of British pioneer work. That this is so is due to the protected markets of our competitors, which enable them to develop a speciality in a way in which our open market does not permit. It cannot be denied that our British merchants have in the past, and in many ways still are, valuable outposts of British trade overseas, but their success has largely depended on British financed enterprises. Now that these are no longer able or willing to support the merchants, the latter are faced with the difficulty of competing in the open market with well-organised rivals. These are quite prepared to buy the goodwill existing in our old-established houses by making generous agency agreements with them, relieving them of many expenses which had been theirs according to old trade custom, and even granting them special rebates. As a result some of these houses to-day represent our competitors to as great an extent as they do our own firms. They attach the prestige of the British merchant to the sale of competing products and our sympathy for their difficulties is therefore much diluted. The troublous times in China have undoubtedly weakened the financial strength of our merchants, and keen competition has reduced their ability to secure an adequate turnover. But it is not good to increase this turnover by taking on a litter of assorted agencies to which the available staff cannot do justice or to force prices down by cosmopolitan, not to say unpatriotic, commission hunting.

The chief need for improvement of our prospects lies in the provision of as many experts as possible, not only to sell, but also to educate the buyers in the use of the plant. Experts are also needed to keep close touch with the buyers' engineers, for one ounce of personal touch is worth a ton of correspondence.

Often agents' criticisms, advice or complaints are scantily regarded because they are looked on as inexpert. The presence of a trained engineer with the agent will lead to better understanding. The situation will be helped if some of the attached experts are trained Chinese students who will be able to secure close touch with their compatriots. The gradual introduction of Chinese into our selling organisations, not only in this way, but also as partners or through subsidiary contracting companies, deserves close consideration.

The use of an agent house in China is the usual method of liaison between manufacturer and customer, though large concerns or groups of manufacturers may see sufficient turnover to justify a China office of their own. With direct representation, of course, the conduct of affairs is simpler, but even in these cases there must be sympathetic and generous treatment from head offices, and more constant touch should be kept with home developments than appears to be arranged at present. Visits of principals and of supplementary experts to branch offices will have a stimulating effect, and similar stimulation is also necessary when agents are employed.

Another point in which manufacturers could help is to be more liberal with consignment stock.

Finally, the efforts of our consular and allied services might be reinforced by attaching trained consulting engineers to assist in the co-ordination of British engineering interests at home and overseas.

If all who are interested in the restoration of British trade in China, both there and in Great Britain, will get together and work together in the common interest the future will be full of hope and of achievement. Only lack of faith in one another can stand in the way

JAPAN AND CHINA.

Concluding Observations.

What are the reasons for the decline of British trade to China and Japan, and how can that decline be arrested and our trade increased? The task before the Mission was to answer these questions after examination and investigation in the markets themselves. In the course of our work we have interviewed many hundreds of distributors, agents, local producers, bankers and others. We have examined the volume and trend of trade in recent years, visited scores of factories and workshops and investigated the channels of distribution, methods of local production, and the needs of the consumer.

From all that we have heard and seen during our inquiries two conclusions of outstanding importance emerge. First, British trade to the Far East has declined of recent years to an alarming extent; and secondly, this decline is due primarily to the high price of British goods in comparison with the goods of our principal competitors—Germany, Japan, and the United States. We do not wish to minimise the importance of other reasons for the decline in British exports to China and Japan. They have been discussed in detail in our report. In the unanimous opinion, however, of the many hundreds of witnesses whom we have interviewed, and with whom we have corresponded in the Far East, price is by far the heaviest handicap from which British goods, generally speaking, suffer in that market. Efficient distribution, effective advertisement, careful packing, credit, study of market requirements, and adequate representation are all aids to sale, but are only truly effective when the goods are competitive in price. In the markets of China and Japan a low price is, generally speaking, an overwhelming advantage which British goods do not possess.

Reduction of Price Essential.

We therefore conclude with one basic observation. The disparity between the prices of British manufactures and the manufactures of our competitors is, in our view, excessive. Production and all other costs must therefore be reduced until the prices of British goods reach once more a competitive level. At that level the natural advantages we possess in world trade—the skill of our artificers, the goodwill of our fellow-countrymen overseas, the convenience of our trading stations, our shipping and financial pre-eminence, and our good name—will reassert themselves, and we may look for a renewal of prosperity. That such a policy will require sacrifices by all classes of the community in Great Britain there is no doubt. Between voluntary sacrifices, however, made now in a national effort towards a prosperous future and sacrifices which disaster will force upon us if we fail to make this effort, there is no question as to what the choice should be. Nor in our minds is there a question as to the choice which Great Britain will make.

A plant is to be put up at Calgary, Alberta, for the experimental extraction of benzine from the waste natural gas of the Turner Valley oilfield.

Large Band Saw.

OUR illustrations on this page represent a large vertical roller-feed band re-saw recently built by Thos. Robinson and Son, Ltd., Rochdale, for re-sawing flitches, boards, &c., as well as "outsides," or "cants," as received from the breaking down log mills, into boards and scantlings. It has been designed specially for forest purposes for dealing with large quantities of hard woods, such as teak and jungle timbers, and will accommodate stock up to 42in. deep by 14in. wide on each side of the saw. The machine will take handsaws up to 10in. wide, usually about 15's gauge—0·72in. thick—which run on pulleys 72in. diameter. The upper pulley is of specially light construction, being built up of a weldless steel rim with staggered high-tensile steel spokes, radiating from a central boss, while the bottom pulley is much heavier, so as to obviate any tendency for the top pulley to overrun it and slacken the tension of the saw between the pulleys and thus cause irregular or "snaky" cutting. Both pulleys have taper mountings on their shafts, to which they are secured in position by fine threaded lock-nuts and keys. This method of securing the pulleys obviates all tendency to "creep" on the shafts—a defect with some parallel mountings.

The bearings for the pulley shafts are of the Skefko double-row, self-aligning pattern, and are shrunk into position on their shafts, while additional security is provided by lock-nuts holding them against shoulders. The bearings are totally enclosed in dust-proof housings and require very rare attention for lubrication. The "straining" mechanism for the saw is highly sensitive and responds quickly to slight changes in length due to heating. It is mounted on knife edges, and sectional weights are provided to allow the stress to be varied to suit the conditions of working. It will be noted that the upper pulley bearings are pivoted on their brackets and that there is no sliding action to impede their movement. The saw guides are of the white metal or screwed stud type, and are easily adjusted or replaced for wear, the upper guide having a vertical movement to suit the depth of work operated by a hand wheel in easy reach of the workman at the tailing-off end of the machine.

The top pulley and its bearings are adjustable vertically for mounting the saw by two square threaded screws connected together by worm gears, the load being carried on ball thrust collars. When it is desired to cant the pulley for tracking the saw, one worm can be thrown out of gear by the withdrawal of a pin in the hand wheel. A cross lining movement is also provided for the top pulley by a handily placed lever mounted on the fulcrum pin of the rear top bearings, the pin being excentric. This movement serves to correct the tendency of the saw to run out of line and is an emergency provision only.

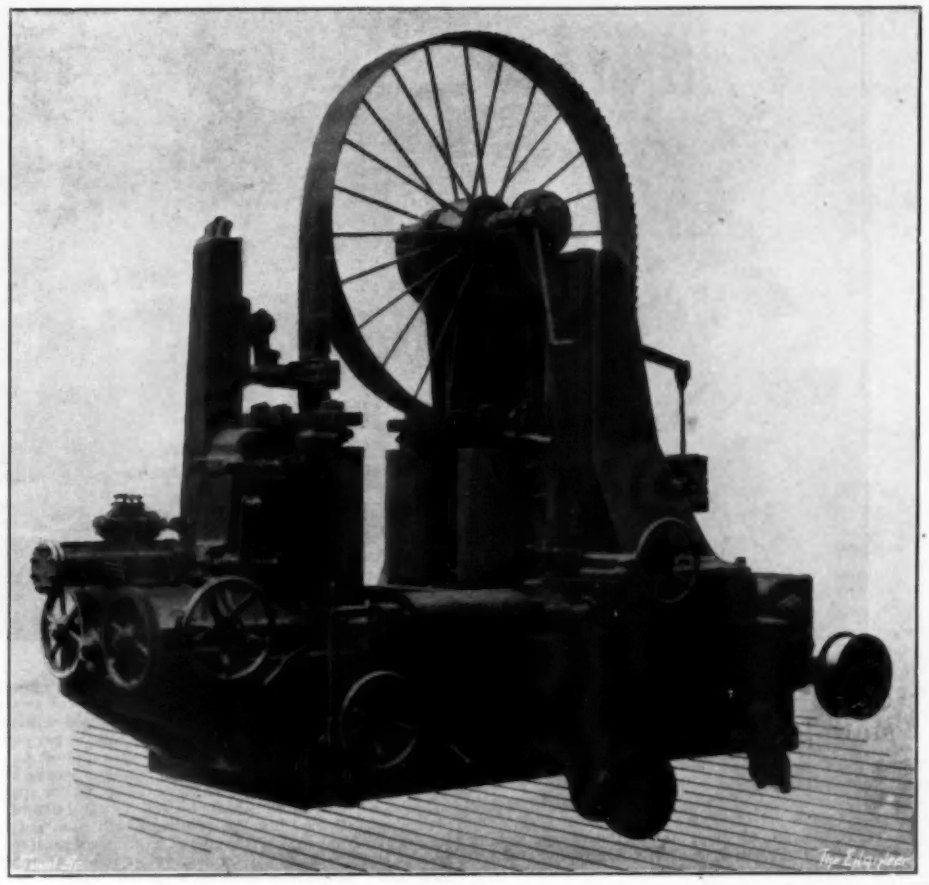
The feed system comprises four fluted feed rollers, 10in. diameter, driven by machine-cut steel spur and bevel gearing from a four-speed gear-box, and alloy steel gears of the sliding type running in an enclosed oil bath with shafts on ball bearings. The brackets carrying the feed rollers are mounted and slide on two circular steel shafts, having a slow rotary movement, to distribute the oil and ease the sliding motion. The two outer feed rollers are carried in swings pivoted to the main brackets and are independently spring-loaded to adapt themselves to irregularities in the thickness of the stock, while pressure is applied to the main bracket by a compressed air or steam cylinder which also serves for adjusting the opening of the rollers to suit the size of stock which is being sawn. The use of fluid pressure for this purpose provides very quick adjustment and, at the same time, allows for very considerable variations in the thickness of the stock passing through the machine. The lever for admitting the steam or other fluid to the cylinder, which operates the rollers, is in a handy position for the operator, and the same remark is applicable to the hand wheel for adjusting the position of the fence or rear feed rollers, both movements having dials or indicators for setting the rolls. The machine is geared to feed up to 200ft. per minute and requires from 60 to 70 horse-power for operating under these conditions.

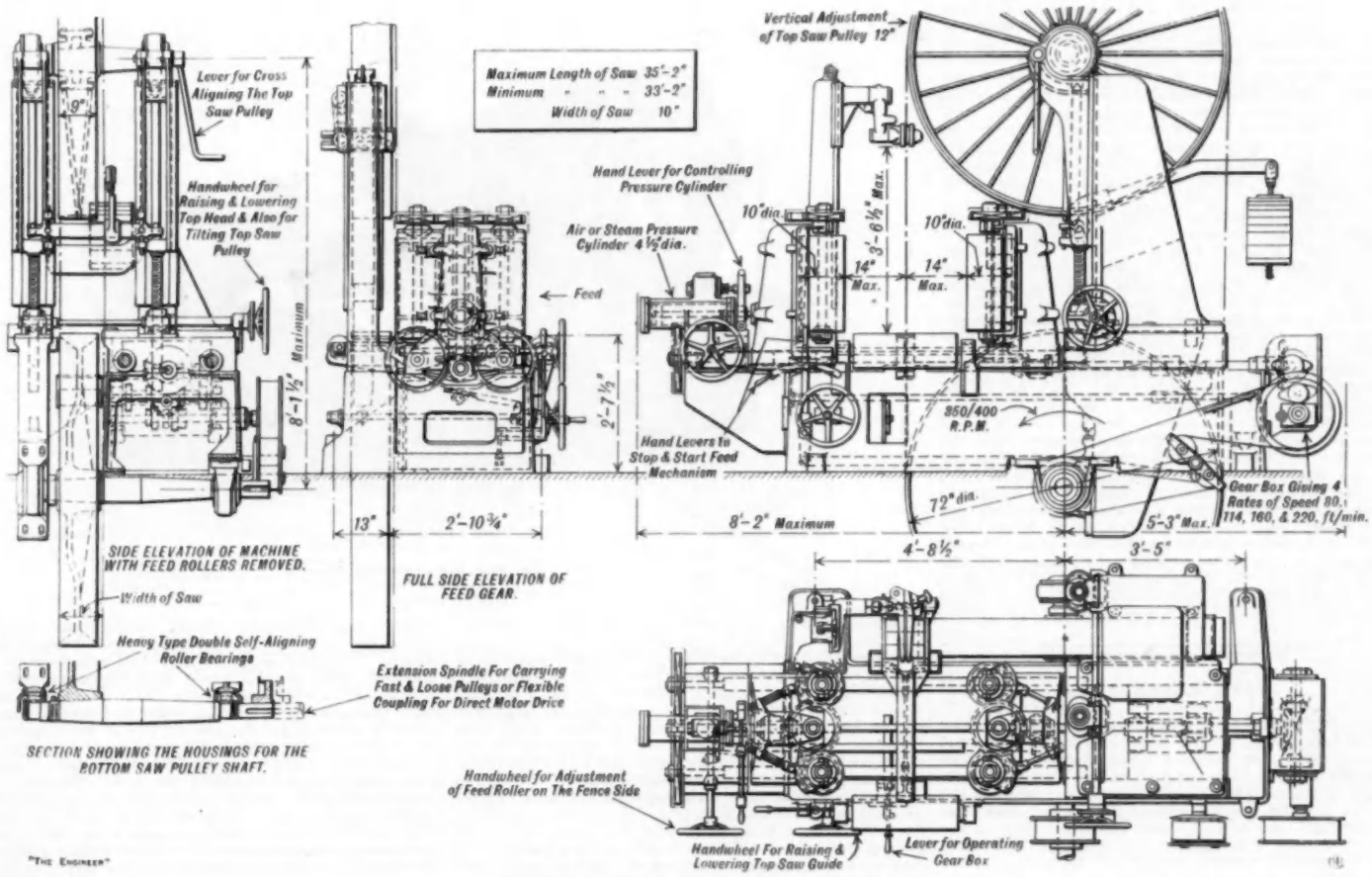
Where the position of the machine necessitates a right-angled drive, mitre gearing with machine-cut steel wheels running in an enclosed oil box and mounted in self-aligning bearings, can be coupled to the bottom saw pulley shaft.

Messrs. Robinson claim that the employment of band saws for this class of operation is preferable to circular saws, as they reduce the saw kerf wastage to the minimum and effect a corresponding saving of timber.

VERTICAL ROLLER-FEED BAND SAW

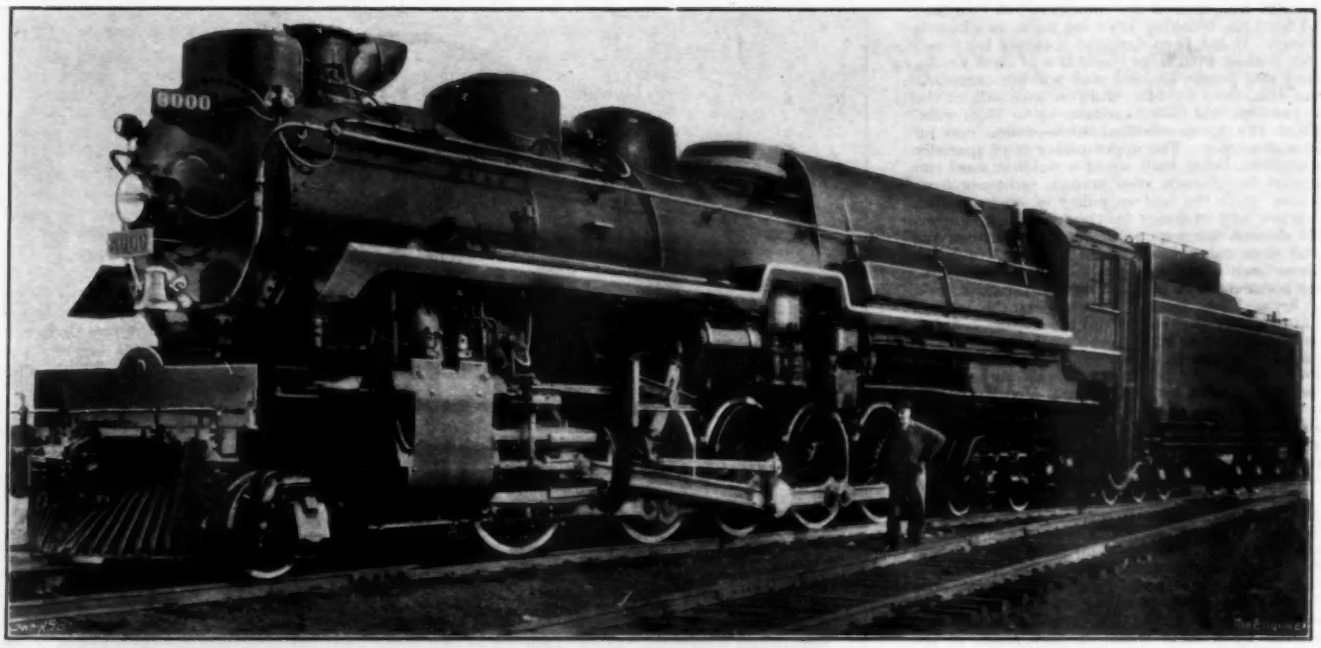
THOS. ROBINSON AND SON LTD., ROCHDALE, ENGINEERS




Maximum Length of Saw 35'-2"
Minimum " " " 33'-2"
Width of Saw 10"
Lever for Cross Aligning The Top Saw Pulley
Handwheel for Raising & Lowering Top Head & Also for Tilting Top Saw Pulley
9"
8'-1½" Maximum
SIDE ELEVATION OF MACHINE WITH FEED ROLLERS REMOVED.
Width of Saw
Heavy Type Double Self-Aligning Roller Bearings
Extension Spindle For Carrying Fast & Loose Pulleys or Flexible Coupling For Direct Motor Drive
SECTION SHOWING THE HOUSINGS FOR THE BOTTOM SAW PULLEY SHAFT.
Feed
2'-7½"
13"
2'-10¾"
FULL SIDE ELEVATION OF FEED GEAR.
Vertical Adjustment of Top Saw Pulley 12"
Hand Lever for Controlling Pressure Cylinder
Air or Steam Pressure Cylinder 4½" dia.
10" dia.
3'-6½" Max.
14" Max.
10" dia.
14" Max.
350/400 R.P.M.
Hand Levers to Stop & Start Feed Mechanism
72" dia.
8'-2" Maximum
Gear Box Giving 4 Rates of Speed 80, 114, 160, & 220. ft/min.
5'-3" Max.
4'-8½"
3'-5"
Handwheel for Adjustment of Feed Roller on The Fence Side
Handwheel For Raising & Lowering Top Saw Guide
Lever for Operating Gear Box
"THE ENGINEER"

ARRANGEMENT AND DETAILS OF BAND SAW

C. P. R.—THREE-CYLINDER MULTI-PRESSURE ENGINE



Canadian Pacific Railway: Multi-Pressure Locomotive.

THERE has recently been on exhibition at the Windsor-street Station, Montreal, a huge locomotive of the "Schmidt" two-pressure type, built at the Angus Works of the Canadian Pacific Railway Company to the designs of Mr. H. B. Bowen, Chief of Motive Power and Rolling Stock, and the American Locomotive Company and the Superheater Company of New York.

This engine, "No. 8000," is intended for goods and passenger traffic in the Rockies, and is far the largest of its type in existence, greatly exceeding in size one now being built by the American Locomotive Company at Schenectady for the New York Central Railroad, which is much larger than the three European engines. As will be seen from our illustration, it has the 2–10–4 wheel arrangement. The driving wheels are 63in. in diameter, and there are two outside 24in. by 30in. cylinders taking steam at 250 lb. and one 15½in. by 28in. cylinder, inside, for steam at 850 lb. per square inch. This high-pressure cylinder drives the second driving axle. The tractive effort is given as 90,000 lb., which will enable the engine to haul a train of 150 forty-ton freight cars, over a mile in length and weighing about 6000 tons on the level. The total weight of the engine is over 205 tons, and of the tender nearly 135 tons, or about 340 long tons in all, and the length over all is slightly over 99·25ft. The locomotive is oil-fired and the tender will carry 4350 gallons of fuel and 12,000 gallons of water.

The boiler arrangement closely follows that of the Schmidt-Henschel designs for the German, French—P.L.M.—and English—L.M.S. "Fury"—locomotives. Steam is generated at 850 lb. in a steam drum by means of a closed circuit—Perkins—heater operating at 1350 lb. The volume of the water in the closed circuit is 300 gallons. The 850 lb. steam is superheated and used at that pressure in the inside cylinder and after exhaust combines with 250 lb. steam from the normal low-pressure part of the boiler before entering the outside steam chests.

According to Mr. Gresley's paper read before the Institution of Mechanical Engineers—see THE ENGINEER, January 30th, 1931—the fire-box heating surface is 515 square feet and the area of the heat transfer coils 750 square feet. The first engine of the type was illustrated by a two-page drawing in our issue of January 30th, 1928.

As this Canadian engine is reported to be nearly twice as heavy as the largest European engine of its type—the P.L.M. engine—and develops nearly three times the power, its career will be watched with great interest, particularly in this country, where the mishap with the "Fury," which is still in the shops, indicated that there is still a good deal to be learned about the system before it can be regarded as out of the experimental stage.

SIXTY YEARS AGO.

THE second siege of Paris began on April 2nd and ended on May 2nd, 1871. Not the Prussians, but the Versailles Assembly were the besiegers. The Commune of Paris defied the national body and had to be forced to listen to reason. For a month the capital was at the mercy of the *canaille*. Of the wanton acts of destruction that were then wrought one of the worst was the felling of the Place Vendome Column. In our issue of May 26th, 1871, we gave a detailed account of the history of the column, and of the manner of its construction. The column was erected by order of Napoleon I. in 1806 on his return to Paris after Austerlitz. He decreed that the bronze of twelve hundred captured guns should be used for its ornamentation. It was to be a stone pillar 144ft. high with a bronze garland twined around it, a bronze ornamental base and a bronze capital surmounted by a figure of Charlemagne—subsequently, after Jena, to have its features modified to those of Napoleon, and in 1833 to be replaced by a statue of Napoleon himself in his familiar habit. The contract for the bronze castings was awarded to De Launay, an iron founder without previous experience of bronze work. The contract price was 5 pence per pound, all the plaster moulds required being supplied to the founder and an allowance of 10 per cent. of bronze being made for waste in casting. The founder's first act appears to have been to raise money by selling the bulk of the percentage allowed him for wastage. He soon got into technical difficulties. His furnaces, improperly constructed and worked without skill, oxidised off much of the tin, lead and zinc in the bronze, with the result that the castings sometimes consisted of little else than red copper. He adopted a novel method of forming his sand moulds. Plaster of Paris patterns were embedded in sand and the whole was heated until the plaster was disintegrated and could be picked out in pieces. The castings produced were so unlike the original patterns that the artists responsible for the designs refused to allow their names to be attached to them. Long before the contract was finished, the founder ran short of metal. He attempted to make good the deficiency by melting up scrap metal with surreptitiously added lead, but was detected by a commission appointed to inquire into the whole business. No legal action was, however, taken against De Launay because it was held that he had delivered castings in an alloy richer in the more precious metal—copper—than the metal he had received in the form of guns. The column was duly completed, but the predictions of the prophets were fulfilled. The differential expansion of the stonework and the metal, it had been pointed out, would result in one or other or both being torn to pieces. Napoleon himself was interested in this point, and is stated to have devised a form of attachment which allowed longitudinal expansion to take place freely. The form finally adopted, however, bound the metal firmly to the stone. As a consequence, so we recorded, the column was visibly bent at the end of a hot summer's day, and in the cool of the evening the shattered stonework could be distinctly heard to crack as it resettled. After sixty summers of such movement, it was no hard task for the Paris mob of 1871 to pull the column down into the dust and to pass on lightheartedly to further destruction.

Electric Deck Winches.

ELECTRIC deck winches have firmly established themselves on liners and large cargo vessels and are now also being used to an increasing extent on the smaller ships engaged, for example, in the fruit trade, where the rapid discharge of cargo is important. Owing to their high efficiency and to the fact that they can be supplied with power by means of cables instead of steam pipes, they have made rapid headway; but the motor and control gear must be properly designed to give the best handling of the load, and it is desirable, if only in the interests of compactness of design, that the mechanical part of the gear should be designed in conjunction with the electrical equipment and the whole work be carried out in one factory. The majority of winches are driven by compound-wound motors fed from the ship's mains through resistance to regulate the speed and to obtain results equal as regards speed over the whole cycle to those of a well-designed steam winch; it is also necessary to make use of series field diversion, generally by means of an automatic load discriminator, in order to allow the motor to speed up under light load conditions. If the motor and control gear are properly designed for the job this type of winch is suitable for ordinary cargo work and is employed in the majority of cases. In addition to winches of this type, however, Laurence, Scott and Electromotors, Ltd., of Norwich, have introduced a self-contained motor generator winch to meet special requirements. While the winch which is shown in Fig. 1 is suitable for ordinary cargo work owing to the many steps of smooth control, the slow crawling obtainable, the complete control of lowering speeds and the stalling conditions obtainable, it is particularly suitable for handling boats or difficult cargo. Some of these winches were shown at the last Shipping Exhibition, and since that occasion a number of them have been in satisfactory operation under sea-going conditions, and it appears that they are likely to become popular on ships on which first cost is not a determining factor.

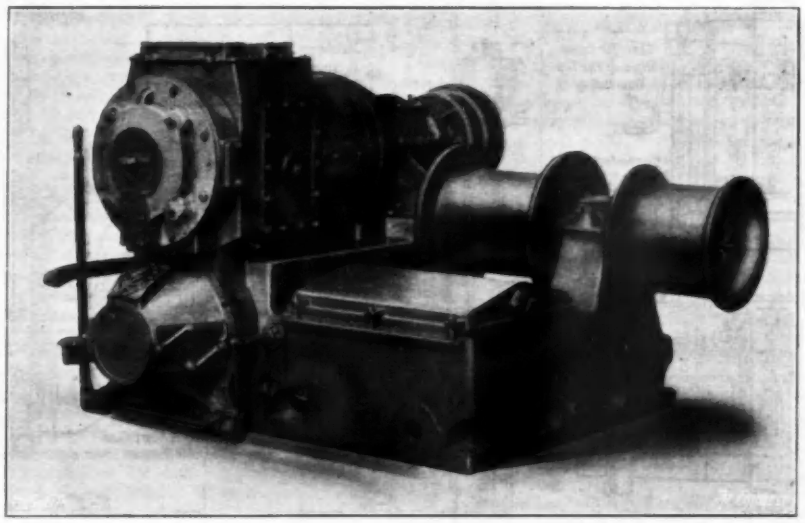


FIG. 1—MOTOR-GENERATOR WINCH

The system of control used is a modification of the Ward-Leonard scheme, and differs from it in that the whole of the

power is not transformed in the motor generator, which can consequently be a good deal smaller than usual. When the winch is about to be used the motor generator is started up as soon as the isolating switch is closed, and it runs light until the winch motor starts. The two armatures A and B—Fig. 2—are connected across the line, whilst the winch motor C is connected across the armature B, and the voltage it receives therefore varies according to the proportions in which the armatures A and B share the line voltage between them. In starting, nearly all the volts are across the armature A, whilst B supplies a low voltage to the winch motor, which gets away slowly and steadily. As the field in which the armature A revolves is weakened and that acting on the armature B strengthened, a larger proportion of the voltage is supplied to the motor C, until finally at full speed it is running practically straight across the line, for although the armature A is still in circuit its field has been reduced until it is taking practically no voltage. While this speed control is being effected by varying local voltage, the necessary current is being supplied to the winch motor and is transformed economically without any loss in main resistances. The current is made up of two components—the part taken from the line

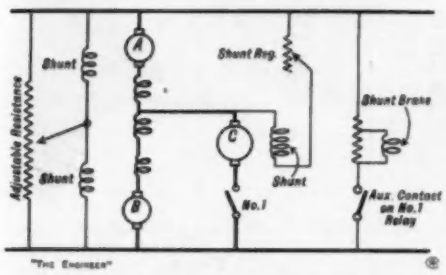


FIG. 2—WINCH MOTOR CONNECTIONS

through the machine A, which is thus driven as a motor, and the part generated locally by the machine B, which thus acts normally as a variable voltage generator.

In order to make a good winch equipment, however, it is not sufficient to provide a succession of fixed speeds, as obtainable with an ordinary shunt regulator. It is essential that the speed on any step should vary automatically more or less inversely with the load, very much in the same way as that of a well-designed steam winch. The importance of this will be realised when it is remembered that out of the four operations that go to make up a complete cycle only one is a load-lifting operation. Another operation is that of lowering load, whilst the remaining two are those of handling the light hook. The lifting load is naturally governed by the size and horse-power of the motor, but the speed of the other operations is only limited by the convenient speed for handling the rope and to some extent by the brake capacity. In order to speed up the complete working cycle it is obvious that the speed under light-load conditions should be allowed to increase automatically to the highest value practicable, as shown by the speed-load curves, Fig. 3, where it will be seen that light loads are automatically lifted at high speeds and all loads, both hoisting and lowering, are under the complete control of the operator. A very slow creeping speed can be obtained with ease, both when hoisting and lowering, even

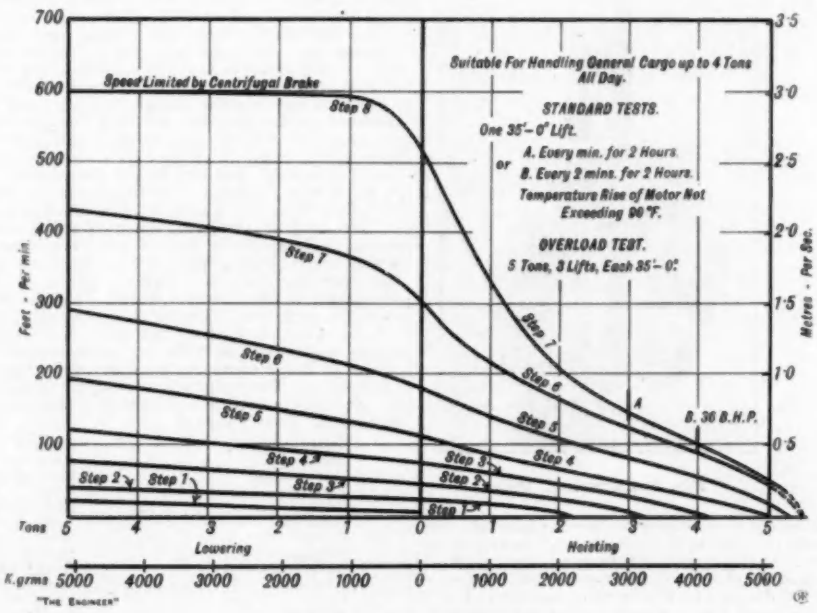


FIG. 3—SPEED-LOAD CURVES OF WINCH

on light hook and when drawing cargo from under hatches. The automatic governing is effected by special shunt and series windings on all three machines, the windings being arranged so that an increase of load on the machine C brings down the voltage on the machine B and increases it on A, so that at heavy loads the winch motor slows down and finally stalls, whilst maintaining its torque, as in the case of a steam winch. Conversely, on light loads on any controller step the voltage of the machine B increases and a relatively high light load speed is given. The standard equipment as shown in Fig. 1 consists of a self-contained motor, motor generator, and the necessary control gear built into the winch so that when the machine is placed on the ship it is only necessary to connect up the pair of mains.

The operator controls the winch by means of a master switch, which is easy to handle and is foolproof, for the operator can manipulate this switch in any manner without doing harm. A magnetic disc brake serves to hold the load, but can be lifted off by a handle for lowering without power. There is also a foot brake, which is interlocked with the controller, so that it can be used for stalling the winch on any step. Normally, however, this is only used in the case of emergency, for the winch can be slowed down and brought to rest gently by bringing back the master switch handle.

As there is a slight natural lag in the building up of the magnetic field, even if the excitation is altered rapidly, the control is very smooth and sudden movements of the master switch do not result in jerks in speed. This, in fact, is one of the advantages of the system when compared with main resistance control, another being the gain in efficiency owing to the absence of resistance losses. It is also possible with this system to approximate much more closely to the ideal speed load curve on which the speed varies over a wide range inversely as the load and to obtain a stalled condition with the torque limited to a safe value on the rope without any abrupt transition due to a discriminating or overload device. As compared with the plain Ward-Leonard system, the reducer scheme is rather more economical, both as regards first cost and running efficiency. As compared with other possible schemes, such as a positive and negative booster, it offers the advantage of requiring less complicated switching with the necessary contactors and of keeping within the limit of the ship's voltage. The system is equally applicable to windlasses and capstans, though in these cases self-contained equipments are not required. The motor is fitted to the mechanical gear of the windlass maker and the motor generator and control gear are mounted separately.

FIVE-TON ELECTRIC LEVEL LUFFING GRAB CRANE

CLARKE, CHAPMAN AND CO., LTD., GATESHEAD-ON-TYNE, ENGINEERS

A Five-Ton Level Luffing Crane Without Luffing Ropes.

A FEW months ago, it will be recalled, a new type of luffing crane, in which luffing ropes were entirely dispensed with, was put on the market by Clarke, Chapman and Co., Ltd., of Gateshead-on-Tyne. The first crane of this special type to be constructed was a 4-ton coaling crane, installed at Deptford, which has now been in operation for several months, and has given entire satisfaction. Among recent orders for cranes of this type the firm has received one for four cranes which will be mounted on the new transporter bridges which are being built for the Gibraltar Mole. The accompanying illustration shows a 5-ton electrically driven crane with luffing, travelling and grabbing motions, which the firm has recently supplied to the order of the West Kent Main Sewerage Board, of Bromley, Kent. Its principal dimensions, loads and speeds are given below—

Maximum working load	5 tons
Maximum radius	30ft.
Minimum radius	12ft.
Lifting speed for 5 tons	150ft. per minute
Revolving speed for 5 tons	2½ revs. per minute
Luffing speed for 5 tons	100ft. per minute
Travelling speed for 5 tons	40ft. per minute
Depth of grabbing below rail level	32ft.

The new level luffing arrangement depends in principle upon a system of levers through which the jib of the crane is balanced by a counterweight. Easy control in the extreme positions of the jib is obtained and the balancing is so devised that the jib tends to take up a position half-way between the minimum and maximum radii, and only a slightly increasing effort is required to move the jib either inwards or outwards from its central position. The saving of rope wear which is made possible by the new level luffing gear is also aided by the fact that the jib and mast pulleys are of large diameter, which also tends to reduce the amount of wear on the lifting rope. The large size of these pulleys may be noted from our illustration. The grab was supplied by Priestman Brothers, Ltd., of Holderness Foundry, Hull.

THE chairman of the S.A. Iron and Steel Industrial Corporation has announced that the problem of making blast-furnace coke from Transvaal coal has been solved by the Corporation, which will now be able to manufacture iron and steel at Pretoria, using coke made from coal found more or less on the spot; but for this achievement it would have been necessary for the iron and steel works to transport most of its coal from Natal.

AN EASILY INSPECTED VALVE

VICTORY VALVES, LTD., STOCKPORT, ENGINEERS

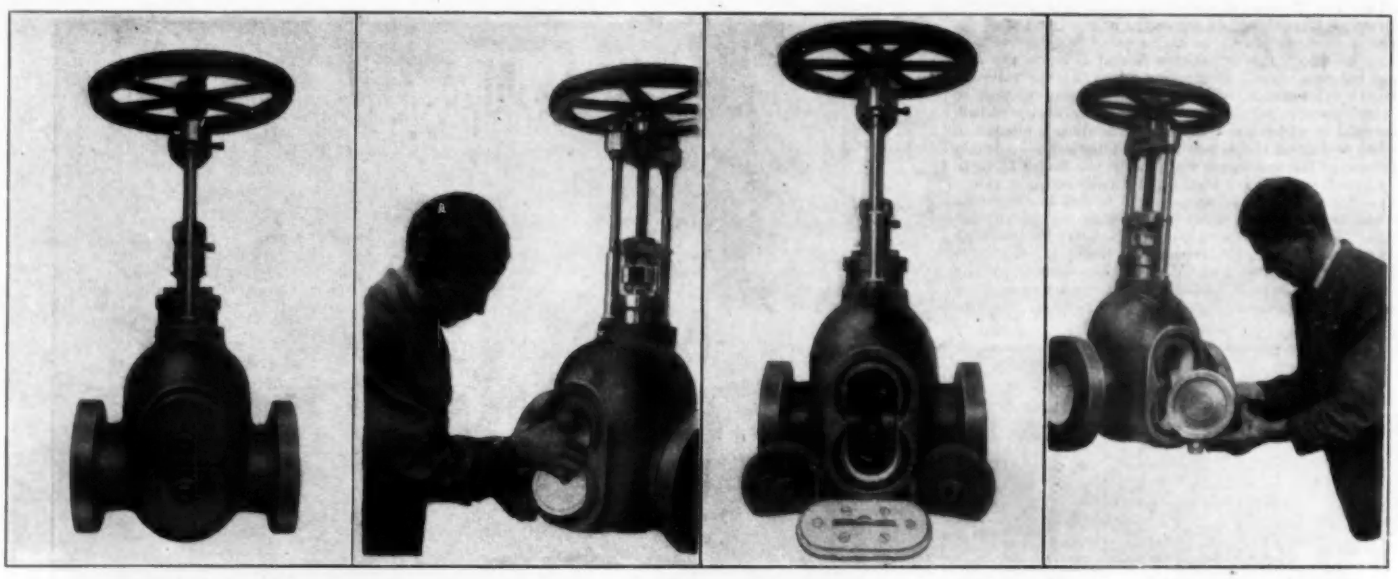


FIG. 1 FIG. 2 FIG. 3 FIG. 4

An Easily Inspected Valve.

THE greatly increased pressures and temperatures of steam which are now in vogue in modern electricity generating stations have led to many improvements in valve construction. The more arduous the working conditions the more do power station engineers feel that all units of their plant should be periodically inspected. With the object of rendering this easy, Victory Valves, Ltd., Adswood, Stockport, a few years ago, introduced the Victory coverless valves with internal sleeves. This firm has now gone a step further by the design and manufacture of valves with internal pressure-held covers. The advantages claimed for this method of construction are several, the principal of which is the ease with which internal inspection can be carried out without disturbing any of the working parts. It is well known that many hours' work are entailed in the inspection of even one large-sized valve of the external bolted cover type, as the valves are often in awkward positions and lifting tackle has first of all to be rigged up to lift the external cover, together with the parts which are attached to it. Particularly is this the case with electrically operated valves fitted with extended spindle gearing for remote operation. Such work frequently necessitates the closing down of a section of a steam plant.

By fitting the Victory internal pressure-held cover the pressure inside the valve is utilised to make a steam-tight joint. It is not necessary for the working parts to be fastened to the cover and, therefore, the cover opening can be situated in the body in the most accessible place for internal inspection, and the withdrawal or inspection of the working parts. The covers can be made reasonably small, and even in the largest valves these can be light enough to be lifted by one man, while all the working parts can be withdrawn and replaced quickly without employing special tools and lifting tackle. The pressure-held cover joint is applicable to all sizes and types of parallel slide valves, junction valves, check feed valves, blow-off valves, &c.

As will be seen on reference to the accompanying illustrations, the ordinary externally bolted cover has been replaced by a cover placed on the side of the valve, which cover is of sufficient size to allow of the insertion or withdrawal of the internal working parts, while the opening affords complete internal inspection of the valve body and the valve operation. The weight of one of these covers for a 10in. bore parallel slide valve is only 25 lb. Our illustration Fig. 5 is a sectional drawing of a 10in. bore solid-forged steel parallel slide valve for 955 lb. pressure per square inch. The group of photographic views—Figs. 1 to 4—shows the process of removal of the parts from a cast steel parallel slide valve. From these illustrations it will be observed that in place of the usual cross clamps fitted to manhole joints two cover caps are provided. These are located by circular machined grooves and serve to support the internal cover when there is no pressure inside the body. The reason for having two cover caps in place of one is purely for ease of handling when it is desired to remove or replace the internal cover. Fig. 2 shows the ease with which even a large cover can be removed. In this operation the cover is removed while the valve is in the closed position, thereby preventing any possibility of damage to the faces or seatings. Fig. 3 shows the internal cover removed and the valve in its closed position. As none of the working parts have been removed, the valve can be operated and its operation noted. Fig. 4 shows the parts being removed for inspection.

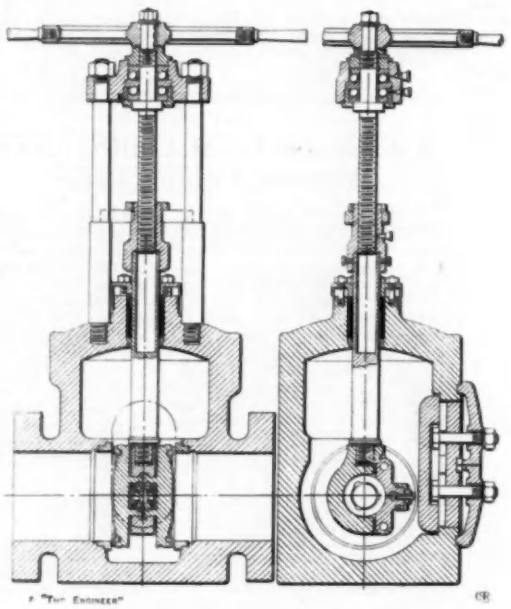


FIG. 5—SECTION OF STEEL SLIDE VALVE

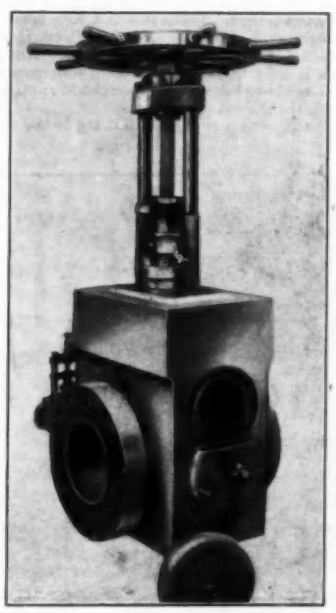


FIG. 6—EXTERNAL VIEW

Referring to the sectional drawing—Fig. 5—it will be seen that the belt eye is similar to a crane hook having its mouth closed by two hinged pieces joined together by a cap nut, which, in turn, is prevented from becoming loose by a strong split pin, the head of which is housed in a recess between the two hinged portions. The hinged portion does not take any of the working stress and serves only to locate the valve discs. The stress is taken by the solid portion of the eye, which is attached to the valve stem. This design permits the discs to be entered and withdrawn singly, and thus, it is claimed, the troubles associated with re-entry and withdrawal of parallel slide valve discs arranged in pairs with a common central spring are obviated. Three small lugs on the spring plates serve to retain the compression of each disc spring to within about ¼in. of its desired loaded length. The outer surface of the spring plates is spherical and the two do not come into contact until the second disc to be inserted is completely seated. Pressing the disc home into the belt eye then loads each spring to its desired length. This form of belt eye also allows for a disc clipping arrangement to be embodied, and it will be seen that the discs cannot open out at the top when the valve is in the open position. Apart from these special features, the remainder of the design is in conformity with the construction usually employed. The valve stem is arranged with a seating at its lower end, which engages with a similar seating underneath the gland, and so allows the gland to be repacked while the valve is under pressure.

"SUTOPPU!"—"ORRAI!"

(From our Correspondent in Japan.)

WHEN the little conductress of a motor omnibus in Japan calls out in a high treble "Sutoppu!" the driver knows she means "Stop," and brings his omnibus to a standstill with a fierceness that throws all the standing passengers off their feet. When his omnibus is making a turn, and out goes her tiny hand, "Orrai!" she calls, and all right it is, the omnibus turning with a suddenness that threatens a turnover, but nothing happens in this land of marvels, and on we go at breakneck speed.

The engineer in Japan has always used the English language to describe machine parts, from the days when boiler explosions were so common in Yedo Bay that a sort of international commission had to be formed to find out what was the trouble. Japan has advanced in engineering since those distant days, but it is a question whether the Japanese will ever get rid of the English language, since words expressive of new ideas and new inventions crowd in so thick and fast that the vernacular is unable to digest them, and must be content therefore with transliteration, of which "sutoppu" is a common example.

There has just been issued a new edition of a dictionary which, beginning in a humble way, now occupies 2250 closely printed pages. For the first time in the history of the language, the editor has thought fit to print an addendum of transliterated words, which have come in with the aeroplane, television, the moving picture, and the motor car. It includes not only material things, but things sentimental, not to say sensual; but I confine myself to a few examples more or less connected with engineering. The reader will, of course, bear in mind that the alphabet is pronounced as they pronounce it on the Continent. Here is the list:—

Baibureta	Vibrator
Bakku-appu	Back up
Bakku-hando	Back hand (drive)
Barubu	Valve
Basu	Bus (motor)
Benchireta	Ventilator
Chubu	Tube
Dampingu	Dumping
Hanga-sutoraiki	Hunger strike
Kondakuta	Conductor
Panku	Puncture
Raji-eta	Radiator
Sefuti-fasuto	Safety first
Supido	Speed
Toki	Talkie
Torakku	Truck
Toransufoma	Transformer
Womingu-appu	Warming up
Yutiritarianisumu	Utilitarianism

THE new Pacific Steam Navigation Company's motor liner "Reina del Pacifico," which left Liverpool on April 9th, arrived at her southern terminal port, Valparaiso, one day ahead of her scheduled time, making the passage, calling at all scheduled ports, in twenty-six days, as against the twenty-seven days which were allowed for her. The normal time for the voyage with other ships is thirty-four days. The liner was fully described in our issue of April 3rd last.

B.E.S.A. Specifications.

INDICATOR COCK CONNECTIONS.

This specification—No. 412—was prepared in view of the desirability of being able to attach indicators of any make to an engine without the necessity of having to change the cock, which would involve the shutting down of an engine. It should, therefore, be of direct interest to all engine builders, and those engaged in engine testing. The indicator end of the cock has been standardised with an external thread and an internal cone. The cylinder end of the cock has been standardised with a ¾in. Whitworth thread with the usual ¾in. Whitworth thread as an alternative. It was decided to adopt the ¾in. Whitworth thread in view of the fact that the ¾in. thread has not given universal satisfaction, and there is a growing demand for a stronger thread. Three standard sizes of Diagram Sheets are recommended.

Copies of the specification—B.S.S. No. 412, 1931—can be obtained from the British Engineering Standards Association, Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

TEST SIEVES.

The British Engineering Standards Association has just issued a British standard specification for Test Sieves. The Committee in preparing this specification has had before it the standard sieves of the Institution of Mining and Metallurgy, together with the standard sieves series of the U.S. Bureau of Standards. Particulars of these sieves are given in an appendix to the specification. It has been considered advisable to divide the British standard test sieves into three series :—

(1) Fine-mesh sieves, made of woven wire cloth, with a size of aperture ranging from 0·0021in. (300 mesh) to 0·1320in. (5 mesh).
(2) Medium-mesh sieves, made from woven wire cloth, with a size of aperture ranging from 1/8in. to ¼in.
(3) Coarse-mesh sieves, made from perforated metal plate, with a size of aperture ranging from ¼in. to 2in.

The series of fine-mesh sieves has a screening area varying between 35 and 44 per cent. The series of fine-mesh sieves is based on a ratio of the fourth root of 2 between linear aperture measurements of consecutive sieves; whilst in the other two series the increments in size of aperture are simple fractions of an inch.

Any individual user of the standard test sieves would not, of course, use the whole range of sieves, and the sizes of apertures of the fine-mesh sieves are so arranged that they may be readily grouped into four complete series, as follows :—

Approximate Size of Aperture in Fractions of an Inch.

1/480	1/400	1/333	1/288
1/240	1/200	1/168	1/144
1/120	1/100	1/84	1/72
1/60	1/50	1/42	1/36
1/30	1/25	1/21	1/18
1/15	1/12	1/10	1/9
¼			

It will be noted that in each group the sieves are so graded that the size of aperture of each sieve is approximately double that of the sieve below it.

In order to simplify manufacture, and thus reduce the cost of production, the Committee have considered it necessary to adopt mesh numbers commonly used, and to specify sizes of wire included in the Standard Wire Gauge series or intermediate sizes which are in common use. These restrictions have necessarily limited the choice of aperture dimensions and rendered the progression of the series of fine-mesh sieves slightly less uniform than could have been secured if odd counts and wire sizes had been adopted. The size of the apertures being the most important feature of the cloth, special care should be taken that it deviates to a minimum degree from the nominal dimensions specified.

It is fully realised that the figures given for tolerance on occasional large apertures are very wide, but it has been found impracticable, in the absence of any reliable data on the subject, to specify closer limits at the present time. They must be regarded as tentative only. The Association trusts that it may have the co-operation of both manufacturers and users in this matter, so that revision of the specification in the direction of greater accuracy and uniformity of aperture size may be possible after one or two years' experience has been gained. Any information as to rapid methods of measuring the aperture size of woven wire cloth, and as to results obtained upon material supplied under this specification, should be sent to the offices of the Association.

The many uses to which test sieves are put are so varied that the Committee is unable to specify the material from which they are to be made. But for ordinary purposes it is recommended that steel should be used for sizes coarser than 40 mesh, and phosphor bronze for the finer meshes.

Copies of the new specification—B.S.S. No. 410, 1931—can be obtained from the British Engineering Standards Association, Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

CORRECTION.—In the Journal paragraph headed "Calcutta Electricity," appearing in our last issue, the statement that the gross revenue was only £27,000 should read "the *increase* in the gross revenue was only £27,000.

ENGLISH TRADE NEWSPAPER IN MOSCOW.—The *British Russian Gazette and Trade Outlook*, which is a privately owned English periodical—with an English and Russian edition—published with the object of promoting British-Russian trade and good relations, has received official permission from the Soviet authorities to open an office in Moscow and to have its own correspondent there. It is the first English newspaper to open an office in that country.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Pre-Holiday Conditions.

OWING to the advent of the Whitsun holidays, local industrialists' material requirements this week have been few, and sales of iron and steel in the Midlands and Staffordshire have been of a very limited character. The position of the basic trades of this area shows no fundamental change from that of the last few months, a shortage of orders being in evidence in all departments of trade. It is not usual for works to be closed down for more than a day or two at Whitsuntide, but order books are so thin just now that extended holidays will be the rule rather than the exception. It is fairly certain that many establishments in the Black Country will be idle for a full week, and even when they resume there is little likelihood of full time being made. It has unfortunately to be recorded that the trade outlook continues rather gloomy, and not only pessimists, but also optimists proceed warily. They hesitate to purchase material until they are assured that they will be able to work it up expeditiously. They are inclined to the opinion that values are more likely to fall than to rise, and this view has been strengthened by the surprise reduction last week in raw iron selling prices. In these circumstances, it is not surprising that the iron and steel market in Birmingham has this week been almost lifeless. Attendance at the Exchange to-day—Thursday—was meagre, and the business transacted was infinitesimal. Conversations as to the prospects of increased demand in the near future were not cheerful. Activity is likely to be most pronounced in the automobile engineering industry, while more movement is also fairly certain in a number of purely seasonal trades. The really heavy engineering industries in Staffordshire show no signs of expansion, while in such trades as those devoted to chain and anchor and edge tool manufacture, the situation is stated to be becoming even worse than it was. Certain sections of the hollow-ware trade are experiencing moderately good business, and the outlook here is not too disheartening. It is hoped that during the suspension of work for the holidays some orders will accumulate at Midland and Staffordshire works, and that greater activity will prevail between now and the next holiday break than has been the case between the last two holidays.

Cheaper Pig Iron.

Users of pig iron in the Midlands welcomed the surprise reduction in raw iron prices announced last week by the Central Pig Iron Producers' Association. They consider that it was long overdue, and that it is a move in the right direction. The reduction which in some zones is 2s. 6d. per ton, amounts in the case of Derbyshire, Northamptonshire and North Staffordshire brands to 5s. per ton, and brings this iron to a price well below the level at which continental iron has recently been offered here. Such a fall in values would in normal circumstances have stimulated demand considerably, but activity at the iron-foundries in the Black Country at date is so restricted that, at any rate up to the present, it has had no material effect upon buying. The market this week has been as dull as ever, but there is some possibility of improved business when the works recommence after Whitsun. Stocks at consumers' works are notably low, and it is just probable that purchases to cover the next few weeks' requirements will be made now that the chances of cheaper iron have for the present disappeared. It is improbable, however, that producers will be able to induce customers to revert to the practice of buying forward, *i.e.*, making contracts to cover three to six months in advance. Lack of confidence, both in the future of trade and of prices, is against such a policy. Northamptonshire smelters are reported to be still selling a proportion of their output outside this district, and by this means they keep down stocks which, without this market, would, at the present rate of production, tend to become unwieldy. Derbyshire blast-furnacemen are disposing of their production. It is interesting to note that the output of pig iron the kingdom over in April totalled 323,200 tons, compared with 357,100 tons in the preceding month and 619,600 tons in April last year. Of the total, 97,200 tons were foundry iron, 16,200 tons forge, 74,000 tons hematite and 122,800 tons basic. At the end of the month there were seventy-eight furnaces in blast compared with eighty-one at the beginning of the month and 151 a year ago. The new selling prices for Midland pig iron are Northamptonshire forge, £2 17s. 6d.; No. 1 foundry, £3 5s. 6d.; No. 2, £3 4s. 6d.; No. 3, £3 2s. 6d.; No. 4, £3 1s. 6d. Derbyshire and North Staffordshire forge, £3 1s.; No. 1 foundry, £3 9s.; No. 2, £3 8s.; No. 3, £3 6s.; No. 4, £3 5s.—all per ton delivered at stations in the Black Country and subject to rebate.

Steel Inactive.

There has been no development of importance during the week in the steel trade and demand remains as torpid as of late. In practically all branches of engineering, there is a shortage of work, and little prospect of increased activity in the near future. The brightest section of the trade is perhaps that providing special steels for the automobile trade. Even here, however, business is below normal for the season of the year. Finished steel prices are as last week :—Angles, £8 7s. 6d.; tees, £9 7s. 6d.; joists, £8 15s.; ship, bridge, and tank plates, £8 17s. 6d.—all less their respective rebates. Boiler plates stand at £9. Values of semi-finished steel are likewise unaltered, small bars being quoted £6 17s. 6d. to £7 5s., according to their base material, soft billets £5 5s. upwards delivered and Staffordshire hoops £9 10s. at makers' works. Continental competitors have lowered their quotations somewhat, but they are securing very little business.

Finished Iron.

I am unable to report any improvement in the Staffordshire finished iron trade. The mills, at present working much below capacity, will probably be idle during the whole of next week. One cannot trace any beneficial effect having resulted from the recent reduction in marked bar prices. Orders come in from day to day, but they are for small tonnages. The strip department, which recently was moderately well engaged, has now become quiet. Quotations for finished iron are :—Marked bars, £12 at makers' works; Crown bars, £9 10s. upwards; nut and bolt bars, £8 12s. 6d.; iron strip, £10 17s. 6d. delivered.

Sheets.

The galvanised sheet market remains depressed. Overseas orders are fitful and small in bulk, but fortunately demand from home sources keeps up well. Prices are unchanged on the basis of £11 per ton for galvanised corrugated sheets of 24 gauge.

Workless.

A further slight decrease in the number of unemployed persons in the Midlands area is recorded this week, the total of 357,704 being less by 1378 than that of a week ago. Of the total, no less than 243,275 are male adults. In the Birmingham area the present figure of 63,509 is an improvement on last week's record of 65,174. In the Stoke-on-Trent area there has also been a decline.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinery Exports.

SHIPMENTS of British textile machinery last month were slightly above the average so far for this year, although well below what they were in April of last year, and less than half the value of the exports in April, 1929. During the period under review, the shipments totalled 4185 tons, valued at £435,428, compared with 7015 tons and £694,516, and 10,781 tons and £971,002 in April, 1930 and 1929. Last month's figures included 2935 tons of spinning and twisting machinery, valued at £303,619, and 930 tons of weaving machinery, valued at £81,849. Exports to British India, which is still the leading market for this class of engineering product, reached a value of £159,207. In no other instance, with the exception of France, were the shipments at all important. That country's takings amounted to £51,363, China coming third with £23,645, followed by South America with £21,771, the Netherlands £17,665, Germany £14,458, the United States £11,193, Japan £10,140, Russia £5957, and Australia £2903, "other European countries" accounting for exports which amounted in the aggregate to £89,037.

Finding a Way Out.

Sir George Bullough, Bart., chairman of Howard and Bullough, Ltd., textile machinery makers, Accrington, dealt at the annual meeting of the company with the difficulties which have confronted textile machinists in both the home and export markets during the past year. The inevitable result of the much curtailed demand has been to accentuate price-cutting in the quest for orders, and the effect of this course, coupled with the fact that short time has been pretty well the general rule in this branch of Lancashire engineering, is adequately reflected in recent balance sheets. During the past year or two amalgamation and rationalisation have been given consideration with a view to finding a way out, but, hitherto, they have come to nothing. Sir George indicated, however, that quite recently further serious conversations have been taking place, and that at the moment negotiations are in progress with the object of arriving at some means of conserving the textile machinery industry. He is hopeful that some definite conclusions will be arrived at in the near future.

For South America.

Following closely, as it does, the Manchester speech of the Prince of Wales on the scope of the South American markets, interest has been aroused in this part of the country by the announcement that Bromilow and Edwards, Ltd., manufacturers of hydraulic and tipping gear, of Bolton, in consequence of the recent British Empire Exhibition at Buenos Aires, at which they were represented, have secured large orders which have necessitated overtime working by an increased staff. Mr. F. M. Edwards, the principal of the firm who has just returned from the Argentine, said that although the country was suffering from the world trade depression, there was a a very big market there, and much activity in connection with road-making and building. British goods were dearer than those of most other countries, but because of their durability, they were, he said, greatly in favour in the Argentine.

Non-ferrous Metals.

Fluctuations have been frequent in the non-ferrous metals market during the past week, although, on the whole, the position at the moment of writing seems to be somewhat steadier than of late. Copper, it is true, has experienced a further setback on balance, but tin has moved up a little, and both lead and spelter have about maintained their ground. Here and there it is reported that the lower levels have brought out a little more buying, although in no section of the market has business during the past week been on more than a very moderate scale. In the case of copper interest among consumers is by no means sufficient to offset the weakening market influence of the adverse statistical position, and prices are again lower by little short of £1 a ton compared with a week ago. The statistical position is undoubtedly unfavourable in the case of tin also, but in this section further drastic curtailment of production is believed to be inevitable, and largely on the strength of this fact the previous week's advance of about 10s. a ton has been followed by another of between £2 10s. and £3. Although still in relatively slow request, lead has displayed no fresh weakness on balance. Spelter is quoted still at extraordinarily low levels, but some measure of improvement in the demand

has served to steady prices to a certain extent, these being more or less where they were a week ago.

Iron and Steel.

The news towards the end of last week that Midland iron masters had decided upon a reduction of half-a-crown a ton in pig iron attracted some attention on this market, without, however, beyond a few orders for small tonnages, bringing out much in the way of improved business. A similar step has been taken by Cleveland makers offering on this market, the current range of values being 67s. per ton for Staffordshire, Derbyshire and North-East Coast makes, 65s. 6d. for Northamptonshire, 88s. for Scottish, and about 82s. 6d. for West Coast brands of hematite iron, all including delivery to consumers in the Manchester area. Lancashire makers of bar iron have also reduced quotations, the first movement in this direction for about a year, but the fact that Crown quality bars are now obtainable at £9 15s. per ton and No. 2 material at £8 5s. has so far had no appreciable influence on the volume of business done. Apart from a constructional contract in Leeds which has recently been placed with a Manchester concern, few orders of any consequence have come the way of constructional engineers in the district, and steel orders from this, as from most other branches of the consuming trades, have been small, both in number and tonnage, the bulk of the transactions being on the basis of rolling programmes. Joists are maintained at £8 15s. per ton, with sections at £8 7s. 6d., 3in. bars at £9 7s. 6d., general plates at £8 17s. 6d., boiler plates at about £9, and small re-rolled bars at £6 15s. Sellers of imported iron and steel materials report no more than sales of odd parcels at easy prices.

Manchester Association of Engineers.

On Wednesday last, the 20th inst., a large party of members of the Association paid a visit to the works of the Broughton Copper Company, under the guidance of members of the firm's staff. The chief departments of these extensive works were inspected, and a good impression was formed of the many and increasing uses to which copper is now being applied. One of the most recent is the manufacture of piping to replace lead pipes for domestic purposes, and the alloying of copper with aluminium and nickel for condenser tubes. Beginning with the laboratory, the visitors were shown through the foundry, the refinery, the rod and tube making departments, and saw methods of annealing. Perhaps the most interesting feature of the visit was the operation of the large extruding presses. At the conclusion of the visit the members reassembled at the Engineers' Club, Manchester, where they were entertained to tea by the directors of the Broughton Copper Company. Mr. Eric Mercer, director, presided and responded to the vote of thanks proposed by the President of the Association, Mr. Strohmeyer.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade remains about the same, and the demand by customers and on local steel account is hardly absorbing the output, let alone reducing the stocks, which, it is computed, stand at over 100,000 tons. The trade with the Midlands continues to be the best. Scotch and Welsh business is inclined to be thin, and continental orders are still on the small side, although deliveries are pretty regular. The demand for special qualities is maintained, but the total does not run into heavy tonnage. Native iron ore is in quiet demand, both locally and otherwise, and foreign ore is experiencing a dull market. The steel trade is quiet, although there are certain factors in the rail market which cause interest. Rails are needed by certain countries, but the difficulties arise with regard to matters of exchange and credit. This position is general in the market, and its application is not local. The Workington mills have been in operation, and they still hold contracts, while the Barrow mills have secured small orders recently which have kept them engaged. Hoops continue in fair demand, and one or two unusual contracts have been completed recently.

SHEFFIELD.

(From our own Correspondent.)

Position Unchanged.

THE position in the various branches of the local steel industry is much the same as last week, which means that it is very unsatisfactory. It is something to be able to say, however, that while the approach of the Whitsuntide holiday has tended to curtail buying, conditions have not become worse. On the contrary, there is some improvement in inquiries for heavy steel material, which encourages hopes of better business after the stoppage. No less an authority than the Master Cutler, in a speech last week-end, expressed the view that the bottom had been reached, and that there were signs of an improvement. No increase can be reported in the production of open-hearth steel, which is at a very low level. There has been a reduction of 10s. per ton in the price of high carbon basic steel, which may stimulate business. The new rate is £8 2s. 6d. to £8 12s. 6d. Prices of soft basic have also been eased. The prices of Northants and Derbyshire forge iron in the Sheffield zone have been reduced by 2s. 6d. per ton. There is not much expectation, however, that this concession will have any great effect for good in the present stagnation. The condition at the foundries is as quiet as ever, and they cannot consume much raw material. Buying continues from hand to mouth.

The Manufacturing Side.

There are few departments of which anything like a satisfactory report can be given. One of the best continues to be that of stainless steel and kindred materials, the output of which still reaches a large volume, although it has not shown signs of progress recently. There is also moderate activity in the production of drop stampings and castings for the motor industry. The heavy engineering shops are very quiet, and have no work of importance in progress. Business is as flat as ever in high-grade steels. While there is a moderate home demand for certain classes of tools, all the factories are on short time, and trade generally consists of oddment orders. The comparative deadness of the export trade is a chief contributor to the present difficulties, as buying in the chief export markets has been reduced to a minute scale.

Foreign Trade in Special Steels.

Foreign competition in the home market in special steels, including stainless and the various other alloy steels in which Sheffield specialises, has been very severe for a long time, but it appears to be falling away just now. The quantity imported during April was only 98 tons, which constituted a low record. The total imports for the first four months of this year were 597 tons, valued at £61,823, as compared with 858 tons, value £92,885, in the corresponding period of 1930, and 1046 tons, value £106,251, in 1929. Our export trade in these expensive products, however, so far from improving, grows worse month by month. The April total of 177 tons was 50 tons down on March, and 73 tons less than in April of last year. The value of the exports over the four months was £111,328, a fall of £82,000. The value of the tools exported in April was equal to that of March, but the quantities must have been larger, as prices have fallen. Slight gains were recorded in saws and engineers' small tools.

A Large Motor Unit.

The installation of an electric drive at the heavy rolling mill of Brown Bayley's Steel Works, Attercliffe, to which I have previously referred, is making good progress. Last week-end there was delivered at the works a 12,000 horse-power rotor in connection with the new equipment. It was brought by road from the Stafford works of the English Electric Company, which is carrying out the work. The rotor weighs about 50 tons, and the main forging for it was made in Sheffield.

Sheffield Gas Grid.

The Sheffield Gas Bill and the South Yorkshire Gas Network Bill are down for consideration by a Committee of the House of Commons on June 3rd. Negotiations are proceeding between the Sheffield Gas Company and the colliery companies which were responsible for the promotion of the gas network scheme. So far, the gas company has agreed to buy gas from fifteen of the thirty companies, but it is reported that the colliery interests will not be satisfied unless terms are arranged with all of them. One of the companies from which gas is to be bought is the Wharncliffe Silkstone Colliery Company, and the chairman of that company, Sir Archibald Mitchelson, at the annual meeting last week, expressed the opinion that the business would provide them with a valuable additional source of revenue. The board had therefore agreed to install more modern plant within the next twelve months. He added that the company had spent from £8000 to £9000 during the past year in necessary capital developments, and it was also arranging for the replacement of its old boilers.

Steel-core Sewage Pipes.

The possibility of using steel pipes for the conveyance of sewage was mentioned at a Ministry of Health inquiry at Middlesbrough last week, and is of interest locally, as well as in that district. The Corporation is applying for powers to borrow £17,900 for works of sewerage, and £20,320 for works of flood prevention. The borough engineer, asked if he had considered the possibility of steel pipes being used for the sewerage scheme, said he had heard that the Ministry had not approved of the use of an all-steel pipe for a proposed main trunk sewer at Stockton. The Inspector remarked that they should endeavour to keep as much work in Middlesbrough as possible, and pointed out that concrete pipes with a steel core had been approved in the case of Barnsley. The borough engineer said that such a pipe had been successfully introduced in the construction of a large sewer at Snowdon-road, Middlesbrough, and added that one advantage of the steel core sewer was that in the event of the steel corroding, the outside covering of concrete remained and would give the pipe a longer life. He undertook to prepare estimates of the cost of steel core pipes and submit them, in conjunction with that of reinforced concrete pipes, for the consideration of the Ministry.

Cutlery and Plate.

The cutlery and plate industries are still very depressed, and, although there is increased activity in one or two directions, signs of general improvement are lacking. One branch which is doing a little better is that of forks and spoons. A few of the large shopkeepers have bought cutlery on an increased scale, and the requirements of caterers continue to be large. There is a substantial output of safety razor blades, although the trade, which was progressive for several years, has now fallen off considerably from its best level. In many cases, both cutlery and plate firms are working short time, and barely earning expenses, while others are still worse off and are losing money. One large cutlery firm, old-established, and for many years prosperous, has closed, and the business and works are being offered for sale privately. There is much quietude in the silver and plated hollow-ware departments. Sales of the very cheapest lines of cutlery and plate compare very badly with those of this time last year. The value of the cutlery exports during April amounted to £44,000, which, while only £3500 below the March figure, was hardly half as much as that of the Aprils of 1930 and 1929. The total for the four months of this year is only £176,100, as compared with £293,230 in 1930 and £340,744 in 1929. There were increases in April in the cases of Canada and India, but falls in all other markets. The trade with Australia has now dwindled to very small dimensions. Whereas, during the first four months of 1929 the exports to that market were valued at £100,000, this year they are down to £27,780. The April figure of £5000 was less than half that of March, and less than a quarter that of April, 1930. Exports of scissors and shears declined from 9000 dozen in March to 1278 dozen in April. The imports of cutlery in April amounted to £37,639, a figure £6000 less than that of March, and equal to that of April last year. The four months' total is more than that of last year, but less than in the corresponding period of 1929.

Water Schemes.

A Ministry of Health inquiry has been held at Bridlington into the proposal of the Corporation to borrow £18,400 for the construction of a reservoir, to hold 500,000 gallons, on land adjoining Scarborough road. The reservoir is to be used as a reserve, and for the purpose of supplying water to neighbouring villages if the need should arise, and its construction will relieve unemployment. Redcar Council has obtained a new water supply by constructing a tunnel to tap a natural underground reservoir in the hill at Upleatham. The supply is by gravitation, and will be more abundant than the old one. It will also be cheaper, as the cost of pumping the water up through bore-holes has been eliminated. It is anticipated that the supply will be adequate for the needs of the town for the next three-quarters of a century at least.

NORTH OF ENGLAND.

(From our own Correspondent.

Cleveland Iron Trade.

IT is difficult to find any encouraging features relating to the Cleveland pig iron trade. During the past few weeks there has been a gradual drift towards much quieter conditions, and, unfortunately, there are no signs of any expansion of operations. Consumers are adopting a cautious policy all round, and the only business passing is for small quantities to meet early requirements. The forward position is more or less neglected. The decision of the Central Pig Iron Producers' Association to reduce the price level of Midlands pig iron by 5s. per ton has reinforced the "bear" pressure in this district, but, contrary to expectations, the Cleveland ironmasters have refused to follow the Midlands lead, and prices are maintained unchanged. It is understood that increased concessions have been offered in Scotland, but they have not attracted any extra business, and the purchase of Midlands iron by local consumers must tend to further limit the already restricted demand for Cleveland iron. There is virtually no demand from abroad. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

Production of East Coast hematite pig iron has been increased this week by the rekindling of two blast-furnaces at the Ayresome Ironworks, Middlesbrough. Quotations for hematite are not fixed and are tending downwards. The small output meets current needs and certain producers have rather heavy stocks. Second-hands still hold a good deal of iron, but are doing little business. By price cutting they manage to sell occasional small parcels to overseas customers, but are not at liberty to undersell makers in home markets. Ordinary brands of East Coast hematite are in the neighbourhood of 65s., with No. 1 quality at a premium of 6d. per ton.

Ironmaking Materials.

There is nothing doing in foreign ore. Consumers claim they can buy best Rubio at 15s. c.i.f. Tees, but sellers refuse to regard that as the general market quotation. Blast-furnace coke is abundant and not easy to dispose of. Good average qualities are put at 16s. delivered at the works in this area, but ironmasters are not inclined to pay that price.

Manufactured Iron and Steel.

Firms producing finished iron and steel in this district are much in need of orders, but hold to recent quotations. Makers of heavy steel commodities complain of acute scarcity of new business. Departments turning out railway material have still a little work to complete. A few inquiries for galvanised sheets are in circulation, but actual buying is still quiet.

The Coal Trade.

Conditions in all branches of the Northern coal trade are very quiet, and every description is readily obtainable. A few owners are moderately well off for trade, but they are not in a very satisfactory position, and, together with all others, are eagerly searching for an outlet for their present volume of output. Prompt business offers very sparingly, and shipments under old contracts are in some instances held up by tonnage shortage. Some coal exporters think that the day is at hand, in view of the general and seasonal dulness in trade, when there will be a revision in prices of certain classes of Durham fuel; but of that there are no signs yet. It is understood that most of the owners are against any variation, and prefer adhering to the current figures. It is a difficult question. Under minimum prices foreign buyers know what they have to pay for British coals, and if they can do better elsewhere, they do. If they have to come to, say, this district in the end for their supplies, they hold off as long as possible, it is suggested, in the hope that a revision of prices may be made in their favour. Thus, a good deal of the business is of a hand-to-mouth character. A dull tone rules in the Northumberland steam coal section. Fitters report being moderately well booked, but would welcome additional orders. Sellers offer freely, but hold for the minimum prices direct; but through contract holders small concessions can be obtained. There are several contract inquiries to be handled this week, but the totals are not likely to cause any definite effect on values, which remain at the minimum. Best Northumberland steams are quoted at 13s. 6d., with seconds at 12s., and smalls at 7s. 6d. While the Durham coal position is mainly quiet, there are some collieries which rarely lose a day and are well supplied with orders to the end of the

month. They are the exceptions, and attribute their briskness mostly to old contracts and a good prompt demand for bunkers by steamers going to the Baltic. Best Durham gas coal is 14s. 6d., and secondary kinds 13s. 6d. Best bunker coal is at 13s. 9d. to 14s. Coking unscreened coal remains an easy trade at 13s. 3d. Gas coke demand is quiet, but no worse than recently. Makers quote steadily for export at 19s. Patent oven coke is in moderate request, and quoted unchanged at 15s. Superior foundry coke is steady at 17s. to 22s., and beehive is nominal at 24s.

SCOTLAND.

(From our own Correspondent.)

Featureless Markets.

THE markets generally are entirely devoid of fresh features. On occasion the inquiries have been more numerous, but any increase in actual business has been lacking. Home bookings are as a rule extremely moderate and export commitments are even more modest.

Steel.

It is said that during the past week there have been numerous inquiries for fairly important tonnages, and it is hoped that although nothing definite has been fixed so far, some good orders will follow. Some makers are benefiting from work in connection with the new Cunarder, and their works are more regularly employed, but as a rule employment is intermittent, the general demand for plates and sections being far below normal. There is a slightly better feeling in the tube trade. Sheets are doing a moderate turnover, but so far there is little sign of a broadening out, and both black and galvanised descriptions require orders to ensure the maintenance of the present output. Prices on the whole are unchanged.

Iron.

The situation in all branches of the iron trade is unsatisfactory. Bar iron and re-rolled steel bars are very idle, and the state of the inquiry is not favourable. Bar iron is unchanged, and re-rolled steel bars are quoted about £6 10s. home and £6 7s. 6d. per ton export. Pig iron is very dull, owing to depressed conditions in the consuming trades and continued imports of Indian and continental iron. Only seven furnaces are in blast, but supplies are ample. Shipments of pig iron during the past week amounted to 171 tons (153 tons foreign), compared with 286 tons (280 tons foreign) in the same week last year.

Scrap.

There is very little demand for scrap material at present, and the market shows further weakness with cast iron machinery at 50s. and heavy steel 41s. 3d. per ton.

Coal.

With a further decrease in land sales, the coal market becomes more deeply depressed. All descriptions of fuel are now freely offered for shipment, but the prices quoted, though easier than of late, are still too high to offer any inducement to importers abroad. Supplies therefore are in excess of demand, and short-time working is all too prevalent. Aggregate shipments amounted to 207,112 tons, against 209,159 tons in the preceding week, and 262,388 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE figures of the Great Western Railway Company show that there was a slight improvement in shipments at the principal ports of this district last week, the total amounting to 469,800 tons, as against 462,600 tons for the preceding week, while, for the corresponding period of last year, the quantity was 507,367 tons. There is, however, no rush for coals on the eve of the holidays, though the loading position is fairly good. At the end of last week the returns showed that the number of idle tipping appliances at the various docks was as high as 37, and only two steamers were waiting to berth at Swansea; but, as the result of arrivals of tonnage over the week-end, the position on Tuesday was that the number of idle appliances was reduced to 22. It will be seen from this figure that there is no undue pressure. On the contrary, there are a number of collieries in need of a prompt outlet for their production and, unfortunately, business for loading during the next few weeks is by no means active. It is not a case of the inquiry from any one direction showing a marked falling off, as business for all directions is unquestionably quieter. Although the tonnage offered for employment is not at the moment really excessive, except in the short trades, outward rates of freight have lost some of their steadiness. Contract business is also slow to make its appearance, and the future of the industry cannot be viewed without certain misgiving. Apart from what may emerge from the discussions taking place between the miners and the Government on the question of a Minimum Wages Bill, there is the uncertainty as to what may be the position in regard to hours of work. Unless legislative measures are taken the 7 hours' day operates from July 8th next, and this, of course, means an addition to the costs of production. There can be no doubt that a difficult time is ahead, and the feeling prevails that the outlook has by no means been improved by the strong utterance by Mr. Shinwell, the Secretary of Mines, at Caerau on Friday last in the course of the Ogmore Parliamentary by-election, who said that "he was doing his damnedest by methods which he believed were the best to try and rid the Welsh miners of this infamous and abominable award"—this reference being to the Schiller award, with which, as a matter of fact, neither coalowners nor miners were satisfied.

Safety in Mines.

A conference outstanding in the history of South Wales took place at the City Hall, Cardiff, on Saturday, for the purpose of considering questions concerning safety in coal mines. It was convened by the Secretary of Mines—Mr. Shinwell—and was one of the most representative gatherings of its kind. The visitors were welcomed by the Lord Mayor—Alderman R. G. Hill Snook—and papers were presented by Sir Henry Walker on "Ways and Means of Increasing Safety in Mines"; by Capt. J. M. Carey, Divisional Inspector of Mines, Cardiff and Forest of Dean, on "Accidents that Should not have Occurred"; by Professor R. V. Wheeler on "Explosions," and by Major H. M. Hudspeth on "Falls of Ground." No resolutions were submitted to the gathering, the conference being purely of a deliberative character. Mr. Shinwell wound up the conference by refuting the idea that compulsion was better than co-operation. He said that he infinitely preferred to get the coalowners with him in any proposal he cared to make. If they all got together the preventable accidents in the mines could be eliminated. He hoped shortly to set up joint safety committees in the various coalfields and possibly at every pit.

Iron and Steel Industry.

The scheme prepared by the Iron and Steel Trades Confederation's Executive for the revival and development of the iron and steel trades, the main proposal in which is the establishment of a Public Utility Corporation to control and organise the industry, came up for consideration at Cardiff on Saturday, when 350 officials of the Confederation, representing 30,000 workers, assembled under the chairmanship of Mr. A. D. Hewlett, of Briton Ferry. Mr. Pugh, the general secretary, presented the statement of the executive council, and, winding up the discussion, said that the Central Electricity Board was an example of the way in which they should travel. The resolution in favour of the executive's scheme was carried with only five against.

Record Pig Iron Production.

The Cardiff works of the British (Guest, Keen and Baldwins) Iron and Steel Company, Ltd., last week established a new record in the production of pig iron. Not so long ago the announcement was made that the No. 4 furnace at these works had broken the weekly British record by producing 4040 tons, but last week this figure was exceeded, the quantity amounting to 4250 tons, which is stated to be about 1000 tons above the highest output of any other British furnace. Recently, the British (G.K.B.) Iron and Steel Company, Ltd., received an order from the Trade Delegation of the U.S.S.R. in Great Britain for 30,000 tons of hematite to the value of more than £100,000 for immediate delivery. Two Cardiff-owned steamers, the "Singleton Abbey" and "Neath Abbey," which have been time-chartered to the Soviet for the annual expedition to the Kara Sea, have just loaded full cargoes of hematite and tin-plates, also some nickel. As a matter of fact, the Russians have also purchased supplies of tin-plate to the value of £60,000, and Richard Thomas and Co., Ltd., have loaded tin-plates on the two above-mentioned steamers.

Mannesmann Tube Works Dispute Settled.

It is satisfactory to announce that the trouble at the Mannesmann Tube Works at Landore has come to an end and the men have resumed work. Negotiations took place in London last week and the outcome was that the proposed terms of settlement were placed before the workmen at a mass meeting at Swansea on Monday, when there was an overwhelming majority in favour of the provisional agreement and a resumption of work on Tuesday. The stoppage of work has lasted twelve weeks. The Town Clerk of Swansea, Mr. H. L. Lang-Coath, was responsible for bringing the parties together to discuss the position. The provisional agreement provides among other points for the appointment of a joint committee representative of the management and of the men to consider a new schedule of prices and rates. In the event of the committee failing to agree, the questions at issue are to be submitted to the arbitrator, Mr. Charles Doughty, K.C., whose decision is to be final and conclusive.

Tin-plate Pool Moribund.

At a meeting of tin-plate manufacturers held at Swansea on Tuesday last, the question of the tin-plate pool was discussed. Although it is reported that no decision was come to, it is understood, however, that the pooling scheme will come to an end about the middle of next month. This scheme came into operation in 1929, but for some time past dissatisfaction has been manifested with its operation, and firms have seceded from it. Tin-plate works are at the moment operating at about 50 per cent. of their capacity.

Whitsuntide Holidays.

The official holidays in the coalfield will be Monday, Tuesday, and Wednesday next. So far as shipment operations are concerned, coal trimmers and tippers will have as their holiday Monday and Tuesday, but on Wednesday two short shifts will be worked, namely, from 8 a.m. to 12 noon and from 12 noon to 4 p.m.

North Wales Coal Audit.

The independent accountants' report for the North Wales coal industry shows that for March there is a credit balance of £2969, or 2·37d. per ton, on an output of 300,779 tons, compared with £8424, or 7·79d. per ton on an output of 259,398 tons for February. The average per ton pit-head proceeds was 13s. 2·18d., as against 13s. 3·39d. in the previous month, and the cost of production 12s. 11·81d., compared with 12s. 7·60d. The output per man-shift worked was 17·90 cwt. and the average wage 8s. 3·05d. The economic wage certified by the accountants was 5·69 per cent. above the basis rates, but the minimum for the district is 22 per cent., and in the payment of this wage there was incurred a deficiency of £59,821, thus increasing the deficiency carried forward to £3,925,942.

Current Business.

The tone of the steam coal market remains quiet, and the position of collieries varies considerably. Some of the leading Admiralty qualities and Monmouthshires are well stemmed, but with others prompt orders are needed. Small coals are as excessive as ever and even-sized coals are not finding any too ready an outlet. Patent fuel and coke remain without feature, while pitwood is in restricted demand and prices are unaltered at 23s. 6d. to 23s. 9d. So far as coal inquiries are concerned, the Spanish Marine are asking for prices for two small cargoes for Carthagena and Cadiz, and the Latvian State Railways are in the market for 100,000 tons of steam coals, but this order usually goes for North country coals.

CONTRACTS.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has received a contract from the Great Western Railway Company for the supply of Mazda gasfilled and vacuum lamps for a year.

SIR WILLIAM ARROL AND CO., Ltd., of Glasgow and London, have received an order from the County of London Electric Supply Company, Ltd., for two 7½-ton wharf cranes for Barking power station.

G. D. PETERS AND CO., Ltd., of Slough, have received an order for forty car sets of power-operated door equipment from the Gloucester Railway Carriage and Wagon Company, Ltd., for coaches under construction for the London Electric Railway, Piccadilly line extension.

THE PEARSON AND KNOWLES ENGINEERING COMPANY, Ltd., has received an order from Milliken Brothers, Ltd., for the fabrication and galvanising of 6000 tons of transmission towers for the South-West England and South Wales electricity scheme. The firm has also received the order for the fabrication and erection of towers for the river Thames crossing, which are the highest self-supporting towers ever built in this country. The value of the contract exceeds £100,000.

DAVIDSON AND CO., Ltd., Belfast, have received contracts for mechanical boiler draught and flue dust collector equipment from the Newcastle-on-Tyne Electric Supply Company, Ltd., for its new power station at Dunston-on-Tyne. The boiler plant for which this installation is intended comprises twelve large units, each capable of generating 156,000 lb. of steam per hour. The mechanical draught plant will consist of 48 electrically driven "Sirocco" fans, 24 for forced draught and 24 for induced draught. For eliminating the dust and grit from the flue gases, 72 Davidson patented direct type flue dust collectors are being supplied in groups of six collectors per boiler unit. The contract includes provision of the regulator equipment, and will amount in value to over £100,000.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE board of Vickers-Armstrongs, Ltd., has appointed Commander C. W. Craven, R.N., to be managing director of all works and shipyards of the company.

COX AND DANKS, Ltd., have removed their offices at Sheffield from Attercliffe-road to Stevenson-road, Sheffield. The new telephone number will be Sheffield 41216 (3 lines).

MESSRS. GEO. A. ORROK, David Moffat Myers and W. A. Shoudy have removed their offices to 21, East Fortieth-street, New York City. Telephone numbers: Ashland 4–5505–6.

FUEL ENGINEERING, Ltd., has removed its registered office from Parliament Mansions, Victoria-street, S.W. 1, to 88, Pearl Buildings, Portsmouth. Telegrams and cables should be addressed "Fuexcol, Portsmouth."

MARRYAT AND SCOTT, Ltd., inform us that the connection between them and John Bennie, Ltd., has been severed. The resignation of Mr. Murray D. Scott and Mr. Howard Marryat from the board of the latter company has been accepted.

THE SPERRY GYROSCOPE COMPANY, Ltd., advises us that it has just completed the construction and equipment of new works and office premises, and that its address now is the Sperry Gyroscope Company, Ltd., Great West-road, Brentford, Middlesex, London. Telephone, Ealing 6771.

THE EALING PARK FOUNDRY, Ltd., South Ealing, W. 5, has taken over the goodwill, pattern, drawings, &c., of the Marcus Allen centrifugal pumps, and has received an order for these pumps for export. The company has also taken over the agency for Great Britain, Irish Free State and British Dominions for foundry equipment made by the Société des Etablissements Utard, France.

HANS RENOLD, Ltd., and the Coventry Chain Company, Ltd., inform us that their various branches throughout the country have now been re-organised or established in the following centres:—London, Bush House, Aldwych, London, W.C 2; Birmingham, 61–65, New-street; Manchester, 308, Deansgate; Leeds, 13–14, Park-place; Bristol, 19, Rupert-street; Leicester, Phœnix Buildings, Berridge-street; Coventry, 11, Warwick-row.

INSTITUTION OF GAS ENGINEERS.—The first International Gas Conference and the sixty-eight annual general meeting of the Institution of Gas Engineers will be held from Tuesday, June 2nd, to Friday, June 5th, 1931. The meetings will take place in the Great Hall of the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. On Tuesday, June 2nd, at 10 a.m., the sixty-eighth annual general meeting of the Institution of Gas Engineers will be held, when the annual report and accounts will be dealt with. The President will welcome representatives from overseas. After the presidential address a paper will be read on "Intermittent Vertical Chambers and Coal and Coke-handling Plant at Southall," by Mr. J. S. Thorman. In the afternoon, at 2.30 p.m., papers will be presented on "Problems of Modern Gas Distribution," by Dr. H. Schütte, of Bremen; and "The Semi-direct Recovery of Ammonia in Gas-works Practice and the Recovery of Tar Acids from Ammoniacal Liquor," by Mr. Alfred L. Holton. On Wednesday, June 3rd, at 10 a.m., after international business has been transacted, the following paper will be read, "The Gas Industry in America," by Mr. Clifford E. Paige. On Thursday, June 4th, the following papers will be read:—"Clean Coal in the Gas Industry," by Dr. R. Lessing; and "An Experiment in Controlling Pressure Conditions within Coal Gas Retorts," by Mr. R. N. Webb. At 2.30 p.m. a general meeting of the Benevolent Fund will be held, and at 2.45 p.m. a paper will be read on "The New Oswald-street Gasworks of the Burnley Corporation," by Mr. J. Herbert Clegg. At 4 p.m. the concluding business of the Conference and meeting will take place. On Wednesday evening, June 3rd, the President will entertain the Council and representatives from overseas to dinner at Grosvenor House, Park-lane, W. 1, at 8 p.m. Many entertainments and visits have been arranged during the week.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	16/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 12 0	—
No. 1 Foundry	3 16 0	—
No. 3 Foundry	3 13 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 5 0	3 5 0
No. 1	3 5 6	3 5 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 6 (a) / 4 3 6 (b) / 4 8 6 (c)	— / — / —

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 0 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 10 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 12 6 to 9 0 0	—
Gas Tube Strip	10 17 6 to 11 0 0	—

STEEL. (d)

	(5) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ¼in. and up	9 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 5 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	11 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 0 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	7 2 6	—
Soft Basic	6 0 0 to 6 5 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	6 17 6 to 7 5 0	—
Billets and Sheet Bars	5 5 0 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	11 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	14/9 to 15/-
Block Tin (cash)	106 17 6
„ (three months)	108 5 0
Copper (cash)	38 17 6
„ (three months)	39 0 0
Spanish Lead (cash)	11 10 0
„ „ (three months)	11 16 3
Spelter (cash)	10 10 0
„ (three months)	10 16 3
MANCHESTER—	
Copper, Best Selected Ingots	42 10 0
„ Electrolytic	43 0 0
„ Strong Sheets	73 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 0 11½
Lead, English	13 2 6
„ Foreign	11 17 6
Spelter	11 0 0
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11½ per lb.	
Ferro Tungsten	1/8½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£20 10 0	7/-
„ „ 6 p.c. to 8 p.c.	£19 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£19 0 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£31 0 0	10/-
„ „ „ 1 p.c. carbon	£34 0 0	12/-
„ „ „ 0·70 p.c. carbon	£36 0 0	14/-
„ „ „ carbon free	10d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 0 0 scale 5/- per unit	
„ „ 75 p.c.	£18 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	14/9
„ „ Splint	14/9 to 16/6
„ „ Trebles	11/6
„ „ Doubles	10/3 to 10/6
„ „ Singles	9/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/-
„ „ Jewel	17/-
„ „ Trebles	11/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/9 to 12/3
Screened Navigation	16/6 to 17/6
Trebles	11/6 to 12/6
Doubles	10/6 to 11/-
Singles	9/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/3 to 11/6
Secondary Steam	10/9
Trebles	11/6 to 12/6
Doubles	11/-
Singles	8/9

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	20/-
Household	30/- to 51/-
Coke	20/- to 20/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/-
Steam Smalls	7/6 to 8/-
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-
SHEFFIELD—	
Best Hand-picked Branch	25/6 to 27/-
Derbyshire Best Bright House	24/- to 26/-
Best House Coal	22/- to 23/-
Screened House Coal	19/6 to 20/6
„ „ Nuts	16/6 to 17/6
Yorkshire Hards	15/- to 16/6
Derbyshire Hards	15/- to 16/6
Rough Slacks	9/- to 10/-
Nutty Slacks	7/- to 8/-
Smalls	4/6 to 6/6
Blast-furnace Coke (Inland)	12/3 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b. 15/- to 16/-	

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/6
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/9
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/6 to 17/9
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	11/6 to 13/3
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/3
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 26/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	20/6 to 21/-
Pitwood (ex ship)	23/6 to 23/9
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	43/- to 46/-
Beans	24/9 to 28/3
Peas	20/- to 21/6
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/6 to 9/6
Steam Coals :	
Large	20/6 to 21/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Trade Reorganisation.

As nothing has so far been done to relieve the stagnation of trade, all hopes of effective measures being adopted to that end appear to have been abandoned. The national programme of public works continues to be delayed, and it is now reported that the Conseil Supérieur des Chemins de Fer has recommended that all new orders for rolling stock shall be suspended. Attention is now centred entirely on the scheme of international reorganisation, and as France is suffering from the same causes as other countries, there is more hope that little time will be lost in devising some way of placing European trade on a stable basis. The French plan which has now been communicated to the Geneva meeting, is too vague to provide an idea of what France will be able to offer as her contribution to the solution. The Union des Chambres de Commerce Maritimes et des Ports Français has issued a manifesto condemning a prohibitive protectionist system, which aims at benefiting some classes at the expense of others. Manufacturers are up in arms against the enormous increase in the duties on agricultural produce. The result of these excessive duties is to raise the cost of living and prevent a reduction in wages which is necessary for the manufacturing industries. The general feeling is, therefore, favourable to some international arrangement which will help towards general prosperity.

National Fuels.

The first of a series of congresses to be held during the International Colonial Exhibition is one of the most important from the national point of view, since it aims at encouraging the use of all home and colonial resources for the production of motor fuels and lubricating oils in sufficient quantity to avoid the necessity of procuring supplies from abroad. Meetings devoted to the different aspects of this problem will be spread over a period of five months. The congress was inaugurated last week in the Exhibition by the Minister of Colonies, and at the first meeting Professor Matignon spoke of the experimental work that had been carried out with the catalytic production of spirit from vegetable oils according to the method devised by Professors Sabatier and Maihle. When works were established to develop the process on a commercial scale, the cost of producing the spirit was so high that the attempt had to be abandoned. Nevertheless, the works are being maintained ready to produce spirit from vegetable oils, should this course be necessary in case of national emergency. Monsieur Kimpflin said that in working out the cost of producing the spirit, no account was taken of the heavy residual oils which were regarded as of no value, but the value of those oils had become appreciable with the increasing use of solid injection engines. The crossing of the Sahara Desert by vehicles with heavy-oil engines had demonstrated the importance of that fuel from a colonial point of view. Another matter referred to briefly was the changed outlook for carbonised wood fuel. Vehicles running on charcoal suction gas in tropical climates have given trouble through the oxidation of engines, but it is claimed that this defect is avoided by a new process of subjecting the wood to a temperature of 275 deg. Cent., which leaves it in the most suitable state for suction gas producers and renders it free from the absorption of moisture like charcoal. Monsieur Dumanois, of the Office National des Combustibles Liquides, dealt with the solid injection engine which, he said, had made less headway in France than in most countries on account of fiscal restrictions. The high duty on crude oils made the price almost prohibitive, and as users were not sure of running the engines profitably, there was not enough business to encourage builders to lay themselves out to manufacture such engines economically. The State has so far refused to sacrifice a source of revenue for the benefit of a national industry.

Belgian Coal Licences.

While coalowners in the North of France complain of the competition of Belgian coal, producers in Belgium affirm that the depreciation of their industry is due largely to the imports of coal from Germany and Holland. Last year the production of coal in Belgium was 27,500,000 tons and the imports amounted to 10,000,000 tons. Since the beginning of the present year the quantity of coal received from Holland and Germany has been steadily increasing. At the same time stocks at the Belgian collieries have risen to 3,000,000 tons, and several pits will have to be closed down almost immediately unless a remedy is provided for this state of things. Coalowners declare that there is no overproduction of Belgian fuel, which can all go into consumption if the foreign coal is kept out of the country. As the result of an inquiry by a commission of coalowners and miners, it was decided that the only effective measure was to create import licences similar to those in operation in Germany, to which country Belgian coalowners are unable to send any coal at all. This proposal has been submitted to the Government, with the suggestion that all the State and official departments should be required to employ Belgian coal as far as possible. There is every prospect that the Government will institute a system of import licences, though it is stated that they will not affect countries like France and Great Britain, in which the commercial exchanges are favourable to Belgium.

Destroyer Record.

The speed record of 41·9 knots attained by the destroyer "Albatros" stood for only a little more than two weeks, when it was beaten by the sister destroyer "Gerfaut" in its trials off Lorient with 42·8 knots. The "Gerfaut" was built at Nantes. It is of 2441 tons displacement, and the turbines develop 75,000 horse-power.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

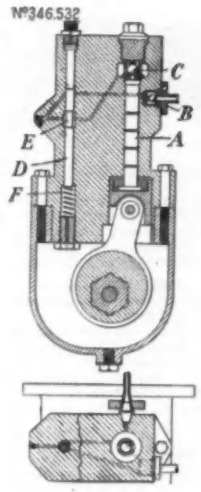
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

346,532. February 27th, 1930.—FUEL PUMPS, L. Costalen, Moorfields Works, Wolverhampton.

This invention is concerned with a by-pass system for the fuel pumps of internal combustion engines. The pump plunger is shown at A. It sucks through the valve B and delivers through C. The pressure of delivery is determined by the secondary

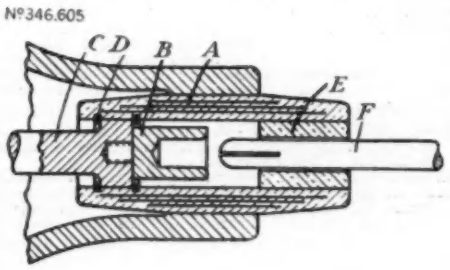


plunger D, which is of slightly different diameters above and below the neck E. In the event of the delivery pressure of the pump rising unduly the plunger D will be depressed against the spring F until the groove above the neck E completes communication through the passages shown from the delivery to the suction ports of the pump.—*April 16th*, 1931.

SWITCHGEAR.

346,605. May 30th, 1930.—PLUG AND SOCKET CONNECTORS FOR WITHDRAWABLE SWITCHGEAR, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

With switchgear capable of being withdrawn or lowered and which is erected where there is a possibility of fire-damp, care must be taken to see that the ignition of the fire-damp is avoided when switching. The invention relates to isolating gear which is operated when the current has been switched off, and is intended to avoid danger due to a residual charge. In accordance with the invention in the hollow insulator A there is the fixed contact B, which is screwed upon a metal body C held in position in the insulator by means of a spring ring D. At the other end of the insulator there is an insulating sleeve E,

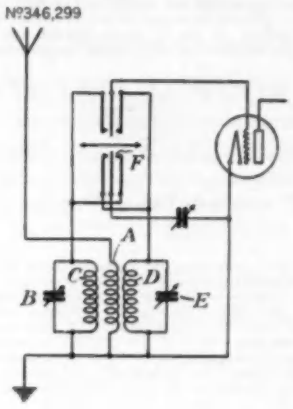


which surrounds a pin F. If, on drawing or pulling the switchgear when no current is flowing a spark occurs at the contact members owing to a residual charge, the fire-damp contained in the insulator is ignited, but the flame expires as it is enclosed in the pressure-proof insulator and the gases passing out between plug contact and the insulator sleeve are so strongly cooled that they cannot cause any ignition of the fire-damp present outside the withdrawable switchgear. If the plug contact be brought into the final open position of isolation of the switchgear, it will pass out of the insulating sleeve without any spark due to a residual charge being able to occur at the same time. As the sleeve E consists of insulating material, no spark due to a residual charge can occur on subsequent connection of the withdrawable switchgear with the bus-bars.—*April 16th*, 1931.

TELEGRAPHS AND TELEPHONES.

346,299. January 7th, 1930.—A.C. FREQUENCY SELECTIVE ARRANGEMENTS, Standard Telephones and Cables, Ltd., and Colin Hector William Brookes-Smith, both of Columbia House, Aldwych, London, W.C. 2.

This specification describes a selective arrangement for a wireless receiver. The receiver comprises an antenna earth system, coupled by means of an inductance coil A, to two closed resonant circuits B, C, and D, E, either of which may be connected into the grid filament circuits of a thermionic valve by means of a switch F. The circuit B, C is tuned to the frequency of one station it is desired to receive, whilst the circuit D, E is tuned to the frequency of another station the signals of which would normally interfere with the signals of the first station. The circuit tuned to the transmission frequency of the first station, which it is required to receive first, is connected by the switch F to the grid circuit of a valve, which may be either a detector or a high-frequency amplifier. The other circuit tuned to the frequency of the interfering station and being still coupled to A, although disconnected from the grid circuit, will absorb energy from the aerial at the frequency to which it is tuned, thus operating as a "wave trap" for the undesired frequency. By throwing over the switch F the circuit E, D may be connected with the grid, and thereby may be made to

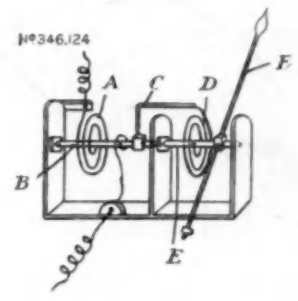


receive the transmission from the second station, whilst the circuit B, C acts as a wave trap for absorbing the transmission energy from the first station. One or other of the transmissions may thereby be selected and undesired transmission rejected by a simple switching process.—*April 7th*, 1931.

MEASURING AND TESTING INSTRUMENTS.

346,124. March 10th, 1930.—ELECTRIC MEASURING INSTRUMENTS, John Westmoreland Record and the Record Electrical Company, Ltd., both of Atlantic-street, Broadheath, near Manchester.

The object of this invention is to provide an improved arrangement of the bi-metal instrument spring which acts as a temperature compensator. The invention comprises an electric measuring

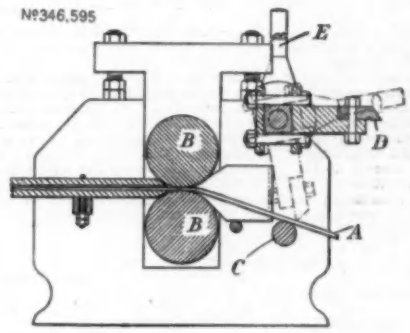


instrument employing a bi-metal spring through which the current flows and a bi-metal spring for temperature compensating purposes. One example of the invention is shown in the accompanying diagram. Current is passed through the bi-metal spring A, which is secured at one end to the spindle B, which is connected by an arm C to one end of a second bi-metal spring D, the other end of which is secured to the spindle E carrying the indicating finger F.—*April 9th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

346,595. May 9th, 1930.—CONTINUOUS ROLLING MILLS, J. Fellows, "Ferndale," Wellington-road, Bilston, Staffs.

In the continuous rolling of strip metal it may happen that the front end of the strip does not enter properly between one pair of the rolls in the mill and is consequently piled up, with dangerous consequences, by the previous set of rolls. The



invention is an insurance against such contingencies. In the illustration the bar or strip is shown at A on its way to the rolls B B. It passes over the bar C and above this there is the pivoted knife D. In the event of any accident the knife is tripped by the handle E and, coming into the position shown by the dotted lines, shears off the strip against the bar C.—*April 16th*, 1931.

TRAMWAYS AND RAILWAYS.

346,151. April 2nd, 1930.—SUPPORT FOR OVERHEAD CONDUCTORS OF ELECTRIC TRACTION SYSTEMS, British Insulated Cables, Ltd., and John William Astley, both of Prescot, Lancashire.

The object of the support for overhead conductors for electric traction systems, described in this specification, is to provide a support for the wire which, as far as possible, will give the same flexibility as that which exists at other points in the wire. The new support has small weight, is subjected to relatively small mechanical stresses, and can be insulated in a simple and convenient manner. The combined ear and hanger constructed in accordance with the invention provides for a certain amount of

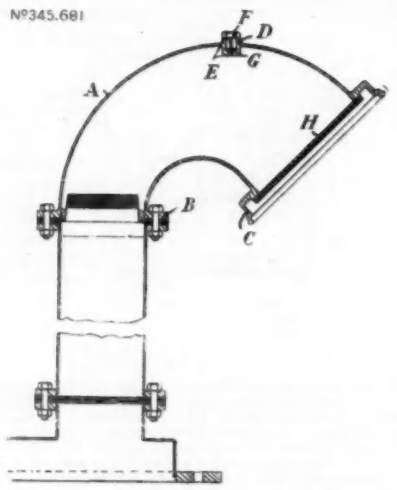
movement in the vertical and horizontal directions, so that oscillations are not arrested, and consequently permits of the parabolic curve formed by the wire being carried past the hanger to the adjacent span. The ear A to which the contact wire is attached is provided with a vertical tongue B, which enters a socket C in the centre of the hanger. The socket C is of approximately the same shape as the tongue B, but is of larger dimensions, so as to provide clearance in all directions between the tongue and socket. A pin D passes through the tongue and socket, and the diameter of the holes in the tongue and socket

is considerably greater than the diameter of the pin in order to give the necessary freedom of movement between the ear and socket. No attempt is made in this type of fitting to insulate the ear from the hanger, the required insulation being provided in the pull-off members, thus enabling the overall height of the cross span and the weight of the hangers to be reduced. In accordance with the arrangement shown in the lower drawing, a pair of hangers E and F are separated by two shackle insulators G and similar insulators are also provided at H and J.—*April 9th*, 1931.

MISCELLANEOUS.

345,681. August 18th, 1930.—PRESSURE RELIEF DEVICES FOR THE CONTAINERS OF OIL-IMMERSED ELECTRICAL APPARATUS, The General Electric Company, Ltd., of Magnet House, London, W.C. 2, and Joseph Goodman, of the General Electric Company, Ltd., Engineering Works, Witton, Birmingham.

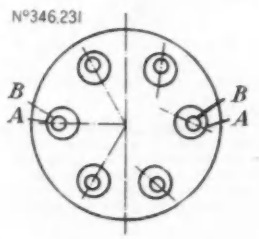
This invention relates to pressure relief valves for containers of electrical apparatus immersed in oil. The outlet pipe A is formed with an annular flange B, a mouthpiece C, and a by-pass D, which comprises two small passages E for connecting the interior of the outlet pipe with the outside atmosphere, and which is fitted with a bolt F, which acts as a weathering device,



and which is provided with a passage G for connecting the two passages E. If desired, the bolt may be removed and a desiccating breather attached to the by-pass. Within the mouthpiece C is a gauze protected diaphragm H, which completely closes the mouthpiece and may be made of glass or any other ruptur-able material. Under normal conditions the pressure on the two sides of the diaphragm H is substantially atmospheric, as any increase of pressure due to a rise in the oil level is released by the by-pass D. When, however, due to a breakdown in the apparatus there is a sudden evolution of a quantity of gas which is too great for the by-pass to deal with, the diaphragm H is ruptured by the increase of pressure, thereby releasing the pressure which might otherwise burst the oil tank.—*April 2nd*, 1931.

346,231. July 1st, 1930.—MERCURY VAPOUR RECTIFIERS, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

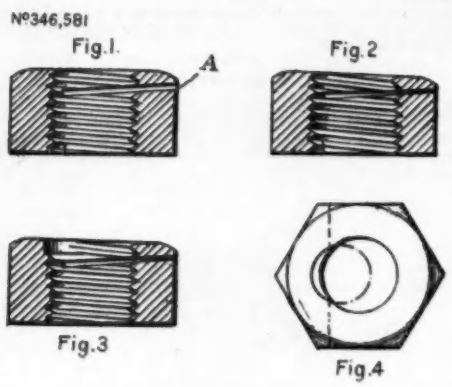
In mercury vapour rectifiers having anodes distributed in a circle and arc guiding sleeves within the rectifier and surrounding the anodes, the anodes have heretofore been disposed centrally in the sleeves. It has been found that with such an arrangement the anodes are seriously attacked and destroyed by the arc at the end surface facing the cathode. This is due to the fact that, with sleeves closely surrounding the anode, the anode drop is small and the arc takes the shortest path to the cathode. According to the invention, this disadvantage is overcome by the sleeve being placed excentrically with respect to the anode. In this



way the space in the sleeve, which surrounds the anode, is widened on one side, so that at this point the anode drop is greater and the arc is forced to travel to that part of the anode which lies nearer to the sleeve and therefore has the smaller anode drop. The arc is thus prevented from settling at one side. In the drawing constructional examples of the invention are shown diagrammatically in plan view, the excentric arrangement of the sleeves A with respect to the anodes B in the left-hand half of the drawing being such that the axes of the sleeves and of the anodes are displaced towards the cathode in the radial direction, so that planes laid through the axes of anodes and sleeves intersect in the centre of the anode pitch circle. The right-hand half of the drawing shows the arrangement as applied to rectifiers in which each two anodes are connected in parallel. The sleeves A in this case are also disposed excentrically with respect to the anodes B, the arrangement being, however, such that the planes laid through the axes of the two intersect short of the centre of the anode pitch circle.—*April 9th*, 1931.

346,581. April 22nd, 1930.—LOCK NUTS, *F. B. Dehn*, 103, *Kingsway, London, W.C.* 2.

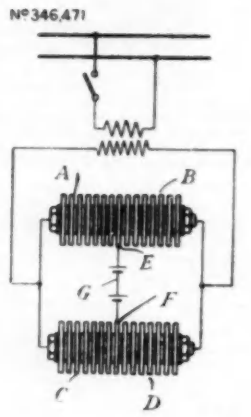
This lock nut is formed by making a nut of the usual simple form and then notching it across, as shown at A in Fig. 1. The notch is then closed by compression—see Fig. 2—and the thread



is partly milled away on the side opposite to the mouth of the notch, as shown in Figs. 3 and 4. It is suggested that the deformation of the nut not only results in a frictional resistance to turning, but also produces a torsional effect tending towards its tightening on the bolt.—*April 16th*, 1931.

346,471. January 17th, 1930.—DRY PLATE RECTIFIERS, Siemens-Schuckertwerke Aktiengesselschaft, of Berlin-Siemensstadt, Germany.

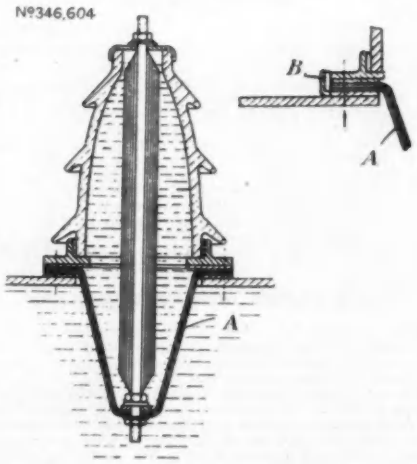
A cuprous oxide plate rectifier constructed in accordance with this invention, consists of four groups of series-connected units arranged in a Graetz circuit, and for the purpose of avoiding damage to the rectifier and the D.C. consuming device, and for convenience in mechanically arranging and mounting the units, the rectifier units are divided into two rectifier columns con-



structed in a manner known but mechanically independent, and free from the possibility of mutual heat conduction. Each column consists of two groups A, B and C, D of plates assembled together under pressure, having points of connection E, F between the two groups of each column, to which points the D.C. consuming device G is connected. While a short circuit in either of the rectifier columns may short circuit the transformer and cause the circuit breaker to open the consuming device D, *i.e.*, an accumulator is not damaged.—*April 16th*, 1931.

346,604. May 29th, 1930.—CONNECTING TERMINALS FOR ELECTRICAL APPARATUS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

In connecting terminals for electrical apparatus it is customary to make the part of the terminal that is under oil in the apparatus of ceramic material, but in the case of very high-pressure apparatus, this practice is expensive and there is a danger of



the jacket cracking under the stresses set up upon screwing. According to the invention, this part, A, of the terminal is made of fibrous paper, such as stiff paper, press paper, or the material known as "Pertmax." With the object of economising space inside the container the jacket is made in the form of a hollow cone. In order to protect the flange portion of the part A from the atmosphere, it is covered by a layer of cement and a thin metal ring B is also provided.—*April 16th*, 1931.

346,632. July 23rd, 1930.—HARD METALLIC COMPOSITIONS, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.* 2.

This invention relates broadly to hard metallic compositions and particularly to an improved method of making metallic composition of the kind consisting of a carbide of an element of the sixth group in the Mendelejeff periodic system of elements, together with an auxiliary metal of the iron group in this periodic system. Compositions of this kind usually consist of tungsten carbide with about 3 to about 20 to 25 per cent. of cobalt. The product contains ordinarily about 6 to about 15 per cent. cobalt with the remainder tungsten carbide and is in the form of a sintered product, the sintering taking place at about 1375 deg. to about 1425 deg. Cent., depending upon the percentage of cobalt in the composition and the time of sintering. The inventors say that they have discovered an improved method whereby they can produce a metallic composition of tungsten, carbon and cobalt such that the finished product will be dense and homogeneous and at the same time very hard. In carrying out the invention the desired amount of carbon is first fired in a reducing atmosphere—for example, in a hydrogen furnace at about 1500 deg. Cent. for about four hours. Lamp-black is preferably used and the heating in hydrogen is to remove any impurities which may be removed by heat. Finely powdered tungsten oxide and the fired carbon are roughly mixed by hand stirring. An example of the proportions which may be used is :—1280 grammes of tungsten oxide to 136 grammes of carbon. This dry mixture of tungsten oxide and carbon is now stirred into a solution of cobalt acetate in distilled water. The reason that the carbon is first mixed with the tungsten oxide is that by so doing it will be wet by water. When the above proportions of oxide and carbon are used, 640 grammes of cobalt acetate and 2 litres of water are employed. This wet mixture is evaporated to dryness in the open air and the heating continued until the cobalt acetate is broken down to the oxide. The resulting powder, which is an intimate mixture of tungsten oxide, cobalt oxide, and carbon, is placed in a graphite crucible and then fired in a hydrogen furnace at about 1150 deg. Cent. for about four hours. This temperature should be held quite accurately, the limits being 1125 deg. Cent. minimum to 1175 deg. Cent. maximum. After firing, the mixture is ready for pressing and final sintering. This may be done either by carrying out the pressing and sintering simultaneously or in separate steps.—*April 16th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Discourse, "X-ray Investigations of the Structure of Liquids," by Sir William Bragg, F.R.S. 9 p.m.

MONDAY, MAY 25TH.

ENGINEERING GOLFING SOCIETY.—Northern meeting at Gullane, No. 1 Course.

THURSDAY, MAY 28TH.

INSTITUTION OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W. 1. Ordinary general meeting, 4.15 p.m.; special general meeting, 6.15 p.m.; annual general meeting, 6.30 p.m.

THURSDAY TO SATURDAY, MAY 28TH TO 30TH.

VEREIN DEUTSCHER CHEMIKER.—Vienna. Fifth general meeting for chemical apparatus. Symposium, "The Separation of Liquids and Solids."

SATURDAY TO SUNDAY, MAY 30TH TO JUNE 14TH.

INSTITUTE OF TRANSPORT.—Italian Tour and Congress. For provisional programme see page 359.

MONDAY TO FRIDAY, JUNE 1ST TO 5TH.

INTERNATIONAL FEDERATION FOR HOUSING AND TOWN PLANNING.—Berlin. Thirteenth International Housing and Town Planning Congress.

TUESDAY TO FRIDAY, JUNE 2ND TO 5TH.

INSTITUTION OF GAS ENGINEERS.—At the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. First International Gas Congress and sixty-eighth annual general meeting. For programme see page 585.

WEDNESDAY, JUNE 3RD.

INSTITUTION OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W. 1. Lecture and demonstration, "The Art of Making and Using Concrete." Lecture I., "Types of Cements and their Peculiarities." 6 to 8 p.m.

THURSDAY, JUNE 4TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "A New Form of Prime Mover and its Uses for Locomotives, Marine and other Engines," by Mr. J. F. J. Malone. 6 p.m.

WEDNESDAY TO SATURDAY, JUNE 17TH TO 20TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Birmingham. Fifty-eighth annual general meeting and conference. For programme see page 524.

WEDNESDAY, JUNE 24TH.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—Annual excursion. Visit to the National Physical Laboratory, Teddington.

MONDAY TO SATURDAY, JUNE 29TH TO JULY 4TH.

INSTITUTION OF NAVAL ARCHITECTS.—Paris summer meeting. For programme see page 514.

MONDAY TO SATURDAY, JULY 13TH TO 18TH.

SOCIETY OF CHEMICAL INDUSTRY.—Jubilee Celebrations. For provisional programme see page 471.

INSTITUTION OF ELECTRICAL ENGINEERS.—The Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1930-31, or accepted for publication: The Institution Premium to Commendatore G. Bianchi; Ayrton Premium to Mr. R. Grierson; John Hopkinson Premium to Messrs. J. W. Rissik and H. Rissik; Kelvin Premium to Messrs. B. L. Goodlet, F. S. Edwards and F. R. Perry; Paris Premium to Mr. P. J. Ryle. Wireless Section Premiums: Duddell Premium to Mr. T. Walmsley. Meter and Instrument Section Premiums: Silvanus Thompson Premium to Professor W. M. Thornton, Messrs. M. Waters and W. G. Thompson.